TECHNOLOGY DEPARTMENT JAN 19 1954

ON THE COVER

A QUARTER-mile inside a mountain, hard-rock miners of Morrison-Knudsen Company of Canada Limited have been carving the largest cavern ever excavated by man. Eight feet wide, 120 feet high and 712 feet long, it will provide room at present for eight 140,000-hp generators, three of which will go into service some time this year. Eventually, the length will be extended to 1142 feet and there will be enough generators to develop 1,172,000 hp of energy. This is a part of the fabulous Alcan Project of the Aluminum Company of Canada, a half-billion-dollar venture to increase the production of aluminum. The power will be used 50 miles away at Kitimat. The cover picture shows how an overhead traveling crane was used to assist in handling the broken rock.

●

IN THIS ISSUE

WHETHER called toll road, parkway, expressway or throughway, it is a modern traffic artery that carries motorists in the United States long distances without crossroad or other interference. The longest one, the New York State Thruway, is now under construction and will extend from Buffalo to New York City, a distance of 427 miles. Its outstanding features and the work of one group of contractors are covered in our leading article, which is to be followed by another in a succeeding issue.

●

NORMALLY it takes a long time to turn an ore body into a producer, but up in Canada a zinc mine was opened up and a concentrating mill equipped to treat 6000 tons of ore daily within 30 months after bore holes had revealed the presence of a sizable deposit. The story of *The Mine that Started Big* begins on Page 10.

●

OTHER articles deal with *Air Starters for Diesel Engines* (Page 15) and atomic power plants for two United States submarines (Page 19).

Compressed Air Magazine

COPYRIGHT 1954 BY COMPRESSED AIR MAGAZINE COMPANY

VOLUME 59 **January, 1954** NUMBER 1

G. W. MORRISON, *Publisher*
C. H. VIVIAN, *Editor* J. W. YOUNG, *Director of Advertising*
ANNA M. HOFFMANN, *Associate Editor* J. J. KATARBA, *Business Mgr.*
J. C. PIERCE, *Assistant Editor* FRANCIS HARTMAN, *Circulation Mgr.*
A. W. LOOMIS, *Assistant Editor* WILLIAM HEINS, *Foreign Circulation Mgr.*
D. Y. MARSHALL, Europe, 243 Upper Thames St., London, E. C. 4.
F. A. McLEAN, Canada, New Birks Building, Montreal, Quebec.

EDITORIAL CONTENTS

New York Thruway Takes Form—*C. H. Vivian* 2
Two New Air Tools Speed Aircraft Production 9
The Mine That Started Big—*Allen S. Park* 10
Air Starters for Diesel Engines—*Copeland Lake* 15
Atomic Power May Be Near 19
Editorials—Toll Road Benefits—Skyscraper Renaissance 21
This and That 22
Pneumatics in Silk-Screen Printing 23
Industrial Notes 24
Quotes from Here and There 28
Books and Industrial Literature 31

ADVERTISING CONTENTS

Allis Co., The Louis 11, 12
Bethlehem Steel Company 9
Burgess-Manning Company 32
Compressed Air Magazine Co. 30
Coppus Engineering Corp. 2nd Cover
Crucible Steel Co. of America 35
Dollinger Corporation 3
Eimco Corporation, The 14, 15, 29
Elliott Company 18
Galland-Henning Mfg. Co. 30
Garlock Packing Company, The 23
Hansen Mfg. Co., The 31
Ingersoll-Rand Company 6, 7, 28, 34
Kewanee-Ross Corporation 16
Logansport Machine Co., Inc. 32
Naylor Pipe Company 26
New Jersey Meter Company 33
Niagara Blower Company 27
Norton Company 20
Punch-Lok Company 25
Reliance Electric & Engr. Co. 3rd Cover
Republic Rubber Division—Lee Rubber & Tire Corp. 13
Sarco Company 33
Sauerman Bros., Inc. 22
Schrader's Sons, A. 19
Shell Oil Company 4, 5
Square D Company 33
Texas Company ..... Back Cover
Timken Roller Bearing Co. 10
Toledo Pipe Threading Machine Co., The 32
Victaulic Co. of America 24
Vogt Machine Co., Henry 17
Walworth Company 8
Wisconsin Motor Corporation 21

A monthly publication devoted to the many fields of endeavor in which compressed air serves useful purposes. Founded in 1896.

CCA **Member Controlled Circulation Audit**

Published by Compressed Air Magazine Co., G. W. MORRISON, *President;*
C. H. VIVIAN, *Vice-President;* A. W. LOOMIS, *Vice-President;*
J. W. YOUNG, *Secretary-Treasurer.*
Editorial, advertising, and publication offices, Phillipsburg, N. J.
New York City Office, 11 Broadway. L. H. GEYER, *Representative.*
Annual subscription: U.S., $3.00, foreign, $3.50. Single copies, 35 cents.
COMPRESSED AIR MAGAZINE is on file in many libraries and is indexed in Industrial Arts Index and in Engineering Index.

THRUWAY ROUTE

Following the historic water-level route, the Thruway will connect the state's two largest cities and pass through areas where four-fifths of its people live. Some time later it will be extended westward to the Pennsylvania line. At the Buffalo end, a feeder highway to Niagara Falls and two Grand Island bridges were taken over in 1952 and have been operated since then by the Thruway Authority. At the New York end, the Thruway will terminate at the boundary line of Bronx Borough, but the Major Deegan Expressway now under construction will carry traffic on into Manhattan.

Super Toll Road

NEW YORK THRUWAY TAKES FORM

C. H. Vivian

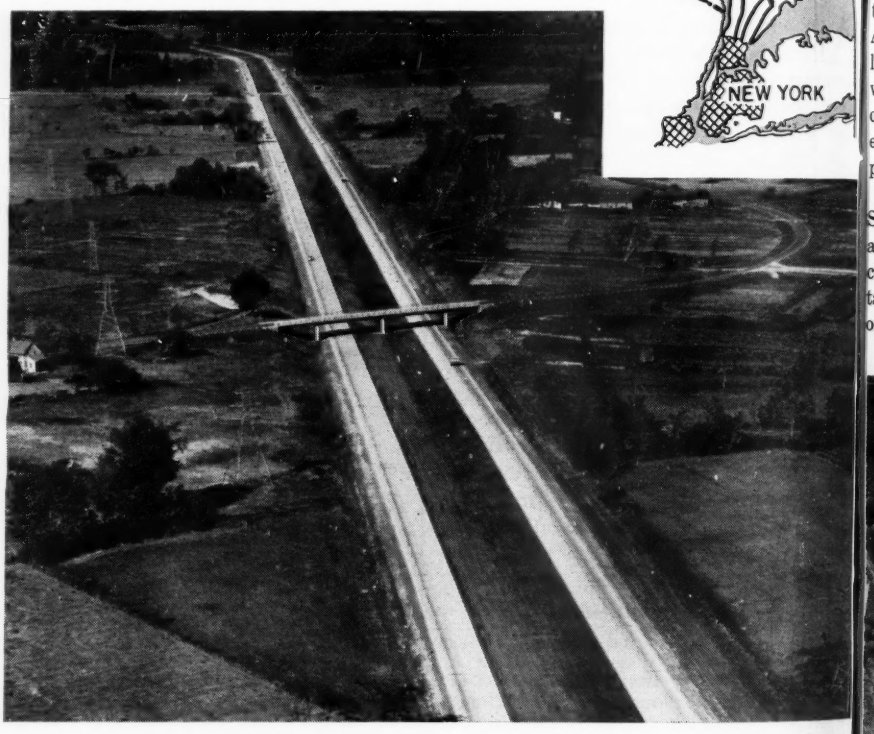
AS BEFITS the nation's wealthiest and most populous state, New York is busily building the longest and most expensive toll road yet conceived. Officially known as the New York State Thruway and scheduled for completion early in 1955, the $500-million expressway will extend 427 miles from New York City to Buffalo. Unimpeded by cross traffic or other obstacles to ordinary motoring, drivers will be able to cruise along its wide ribbons of concrete laid on wide-sweeping curves and offering long-distance vision and grades so moderate that gear-shifting will be rare.

Entering and leaving by any one of 53 interchanges, motorists may glide through some stretches of magnificent scenery and pause as they will at conveniently located service areas affording all facilities for ministering to their wants and those of their cars. At one point in the Rochester district, the designers even changed the original line by dividing the Thruway so that it will pass on each side of a well-stocked trout stream. The planners estimate that 55 million trips will be made on the thoroughfare during the first full year of operation of the entire system.

The new route will be a superhighway in every sense of the word. Nowhere will the right of way be less than 200 feet wide, and in some stretches it will reach 800 feet. Normally there will be two lanes, one 12 feet and the other 13 feet in width in each direction, separated by a central mall at least 20 feet wide. But where traffic warrants it, there will be a third 12-foot strip, bringing the width of pavement on each side to 37 feet. Elsewhere, provision will be made for adding the extra lanes whenever they are needed. Flanking the concrete strips and having a width of 9 or 10 feet, depending on the terrain, stabilized shoulders will permit off-pavement parking of the heaviest vehicles. Shoulders along the inside edges will be 7 feet wide, of which 4 feet will be stabilized.

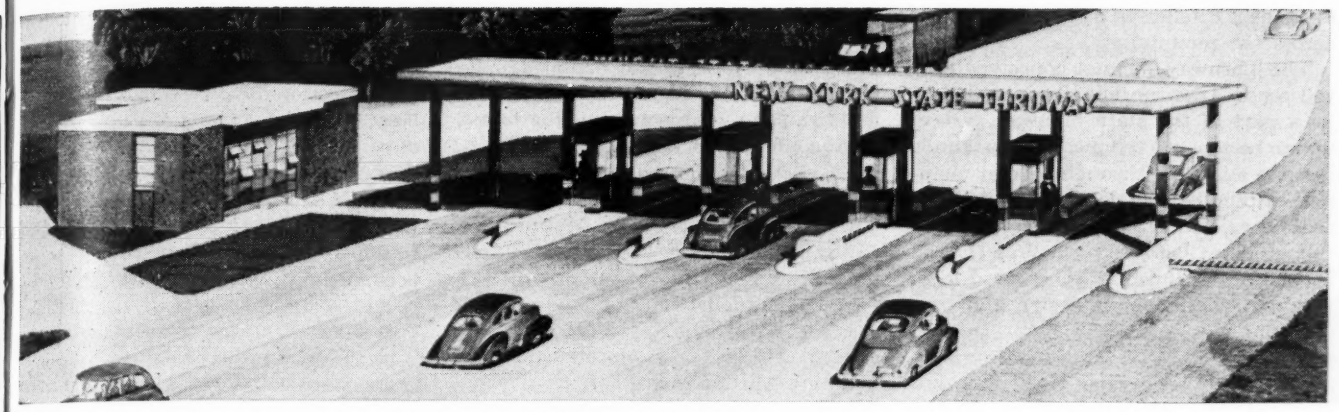
Around 500 bridges, or more than one per mile, are called for. Most of them will be overpasses for roads, but some will be sizable structures to carry the superhighway over waterways, ravines or railroads. By far the most important one will be the Hudson River crossing that will be mentioned later. All Thruway bridges will be six lanes wide.

Around 20,000 acres of land, consisting of some 10,000 parcels, had to be acquired, and that involved preparing a map in each instance. However, it is not



SECTION IN SERVICE

Motorists are now using this completed stretch near Canastota east of Syracuse in central New York. Note the width of the central mall. The opposing traffic lanes will be far enough apart to eliminate headlight glare.



TYPICAL TOLL-COLLECTION STATION

Tolls will be collected at 35 locations. As a driver enters one of these interchanges he will receive a card showing the time and place of entry and the type of car. Upon leaving the Thruway he will present his card to a collector and a machine will automatically compute the toll he owes. Owners of passenger cars registered in New York State will be able to buy a yearly license that will permit them to use the Thruway without further charge.

so difficult to obtain property for such purposes in New York as in some other states. The law provides that a public agency may gain title by filing a plat of the piece desired with the county clerk. An appraiser then sets a price on the land, and if the owner is not satisfied with the figure designated he may go to court. In the case of the Thruway, however, this was done in only a very small percentage of the properties.

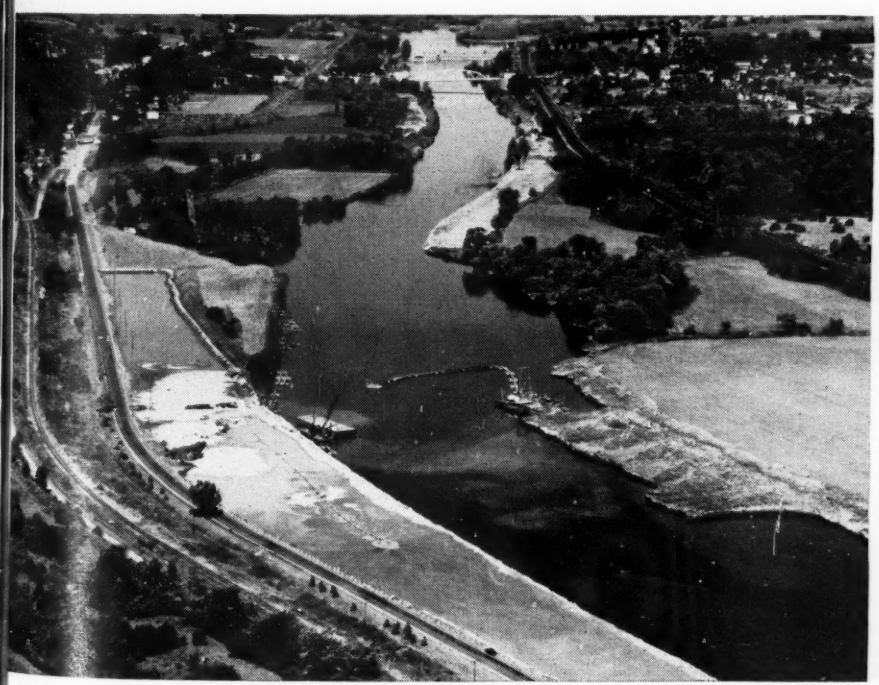
Passenger cars registered in New York State will be able to use the Thruway on annual permits. For other vehicles, the charge will vary according to the distance traveled but will be approximately one cent a mile for passenger cars, up to 3.3 cents for heavy trucks and 3.5 cents for buses. Tolls will be collected at 35 interchanges, which will be designed so that all vehicles will go through a single pay station. In addition, there will be three free interchanges in the Buffalo area and fifteen between Suffern and New York City, thus permitting local traffic to use the thoroughfare without charge.

Various steps are being taken to promote safety on the Thruway. The minimum radius of curves will be 2800 feet, and clear vision ahead of at least 1000 feet will be afforded everywhere. There will be acceleration and deceleration lanes 1200 feet long at all interchanges, and these will reduce the hazards occasioned by cars entering or leaving the main traffic streams. To minimize sideway skidding in wet or slippery weather, the surface of the pavement will be purposely roughened by dragging burlap over the wet concrete before it has hardened.

To combat the monotony of driving that sometimes leads to "highway hypnosis," some stretches that could be built straight will follow sweeping curves. The mall between opposing traffic lanes will be wide enough (at least 20 feet in 6-lane and 44 feet in 4-lane sections) to eliminate headlight glare. For the same reason, existing trees will be left in the center strip wherever possible. Finally, the legal maximum speed, which was originally scheduled for 70 miles per hour, will be set at 60.

A glance at the accompanying map will show that the Thruway will not follow a direct course such as a crow or a bee would choose; but the path has been the main avenue of travel and commerce from time immemorial because it is essentially a water-level route. Long before the coming of white men, Indians wore deep trails there. These became the first man-made transportation artery across the state—the Erie Canal which links the Great Lakes with the Atlantic Ocean by way of the Mohawk and Hudson River valleys. The same course was later chosen by the New York Central Railroad.

Population and industry were naturally drawn to this convenient trade route. Today, New York's largest cities, greatest industrial centers and four-fifths of its inhabitants are located in these two valleys and on westward to Lake Erie. Automobile traffic has consequently reached peak proportions throughout this zone and made it the logical throughway. Fortunately, it is also the best all-year travelway. Being close to sea-level elevation from end to end, it will not feel the interrupting bite of snow and ice as



MOVING DAY FOR CANAL

In order to fit the new expressway into the crowded Mohawk River valley between Albany and Utica, the State Barge Canal is being moved over at five different places. This aerial view shows a suction dredge eating away at the right bank of the waterway. The water-borne material excavated there is being piped into the area at the lower left where the Thruway will run.

much as if it followed a more direct path across the mountains.

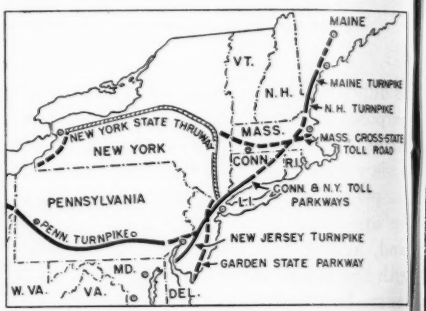
The Thruway was not conceived as a toll road. It was originally intended to be a part of the state highway system and to be constructed piecemeal as funds became available through regular channels. Actually, a little of it was built on that basis. Such a trunk line had been talked about before World War II, and legislation establishing its general location and endorsing its design and construction was enacted in 1942. In 1944 the legislature, acting on the recommendation of Gov. Thomas E. Dewey, authorized the Department of Public Works to carry out the project as fast as funds would permit.

The surge of wartime traffic, coupled with reduced building operations and maintenance enforced during that period, hastened deterioration of the highways, especially in industrial sections, and aroused alarm over the condition of the network. Governor Dewey informed the legislature in 1945 that one-third of the state system needed immediate reconstruction and that the remainder would require above-normal attention as soon as the emergency was over. It was apparent that there would be little money left over for a throughway, but nevertheless, a start on it was made in 1946 on a section at Liverpool, near Rochester, and on others in Greene and Ulster counties north of New York City. It was soon evident, however, that it would take so long to build the expressway under existing conditions that it could not serve the purpose of relieving current traffic congestion. And the need for it was fast growing worse, as indicated by the rise in motor-car registration in the state from 2,454,000 in 1945 to 3,566,000 in late 1949.

Faced with these circumstances, Governor Dewey, in February, 1950, appointed a committee to consider a plan for making the Thruway project a special order of business to be financed independently of existing sources of revenue and to be paid for by charging for its use. The committee's report of March 4, 1950, became the basis in the same month for a law that established the Thruway Authority to be administered by three members appointed by the governor. Bertram D. Tallamy of Buffalo, R. Burdell Bixby of Hudson, and David J. Martin of New York City were named and are now serving with Mr. Tallamy, the chairman.

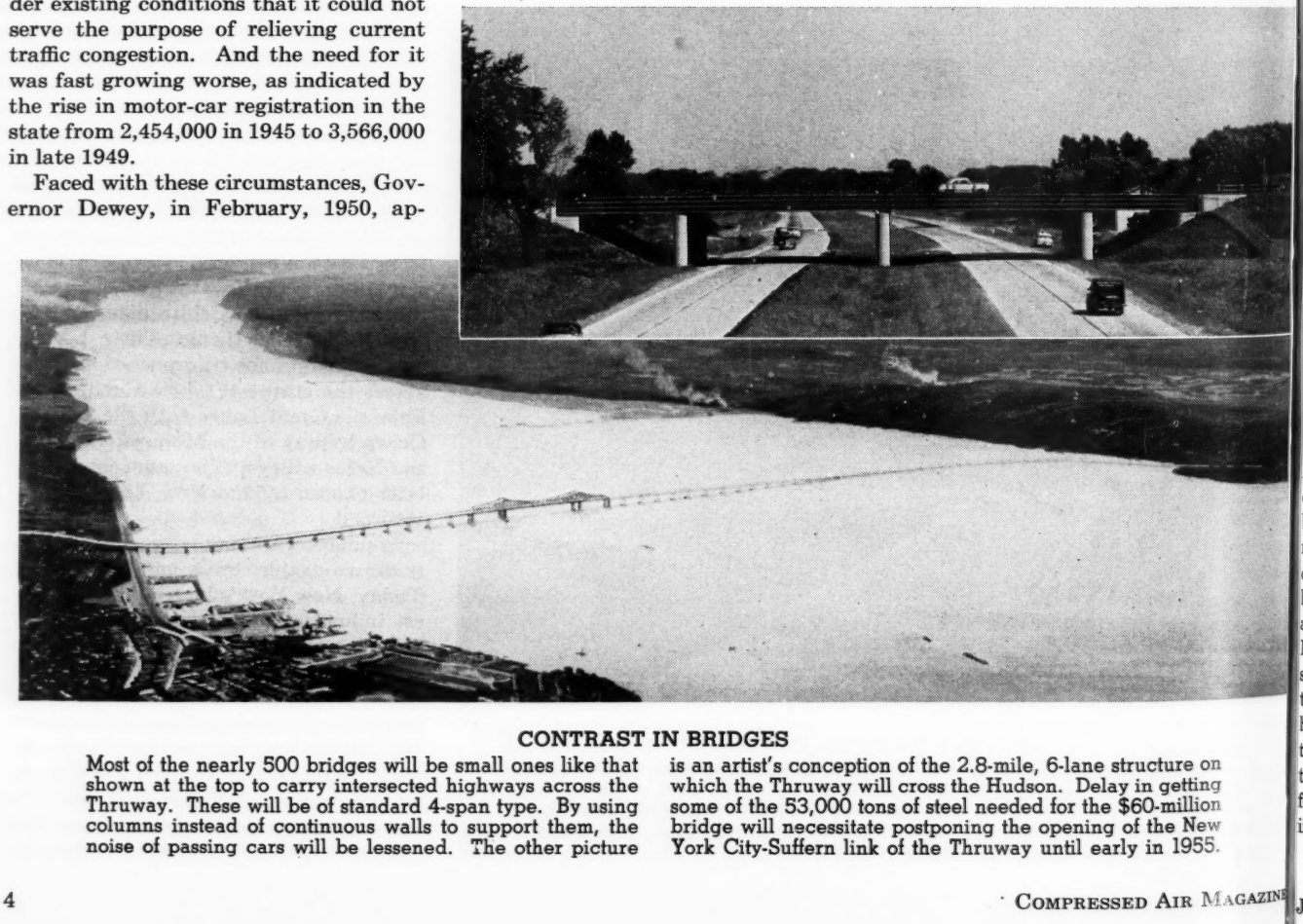
The Authority was empowered to design, build, maintain and operate the new facility and to finance construction by issuing bonds up to $500 million. To make the debentures attractive to investors and to establish a lower rate of interest than would otherwise have been possible, the legislature, and then the voters—at the November, 1951, election—approved an amendment to the state constitution to place the state's credit behind the bonds. It is estimated that as a result of this move, the more favorable terms of raising the money will save around $120 million during the life of the debentures.

The Thruway act permitted the Authority to draw on existing state departments for help and also to employ private professional and technical consultants. It has taken full advantage of those provisions. In consequence, the Thruway organization proper numbers only around 65 persons. About one-fourth of the designing and half of the field direction have been handled by the New York Department of Public Works, of which Mr. Tallamy is superintendent. The remainder of these tasks have been assigned to 34 private firms. To expedite the huge undertaking, it was divided into 66 subdivisions. Actual construction is carried out by contractors. Practically all the larger firms in the northeastern part of the country that engage in this type of work are represented by one or more contracts. For the most part, competition for the jobs has been keen, and in many instances eight or more bids have been received.



CONNECTING EXPRESSWAYS

Shown here is the Thruway route, together with the locations of other eastern superhighways. Those in use are designated by solid lines; those under construction by broken lines.



CONTRAST IN BRIDGES

Most of the nearly 500 bridges will be small ones like that shown at the top to carry intersected highways across the Thruway. These will be of standard 4-span type. By using columns instead of continuous walls to support them, the noise of passing cars will be lessened. The other picture is an artist's conception of the 2.8-mile, 6-lane structure on which the Thruway will cross the Hudson. Delay in getting some of the 53,000 tons of steel needed for the $60-million bridge will necessitate postponing the opening of the New York City-Suffern link of the Thruway until early in 1955.

DOODLES ON THE LANDSCAPE

Artists' presentations of two interchanges. The one shown at the top is at Fultonville in the Mohawk Valley and is of the "single-trumpet" type. The bridge in the foreground carries the Thruway across the river, the State Barge Canal and Route 5-S. To assure free movement of all vehicles, the "double-trumpet" design will be used wherever traffic is normally heavy. Even the smallest interchange will cost approximately $500,000. Some, such as the one seen in the other picture, will come much higher. It represents the finished appearance of the complicated interchange and toll plaza at Suffern, where the new expressway will connect with Route 17 which now carries heavy traffic between New York City and the Catskill Mountains. Here the Thruway will work its way along the Ramapo Valley.

When the Thruway Authority took over the project, $40 million worth of highway had been completed and the remainder of the route tentatively laid out. The Authority immediately speeded up detailed planning and was able in 1952, the first big construction year, to let contracts calling for an outlay of $136 million. This pace continued in 1953, and as of the first of last November 59 miles had been finished, 351 miles was in hand, 8 miles had been advertised for awarding contracts, and only 9 miles of the 427 had to be put underway. A section of about 100 miles between Verona and Rochester will begin the collection of tolls sometime next spring, so far travel on the several shorter completed stretches having been free. It is planned to open the entire line from Buffalo to Suffern by the end of 1954 and the final 30 miles from Suffern to New York City early in 1955.

Congestion in some constricted zones has made it difficult to hold to the objective of keeping the Thruway near sea level throughout. Between Schenectady and Utica the only low-level route is through the narrow Mohawk Valley, which is already carrying two railroad lines, two highways and the State Barge Canal. To thread the new thoroughfare in among these, the canal has been diverted in five places, and this has involved excavating 5 miles of new channel 200 feet wide. West of Utica, a meandering stretch of the Mohawk River has been moved over and straightened. Near Little Falls, the tightest spot of all, it has been necessary to shift the superhighway to a hillside a few miles south of the town.

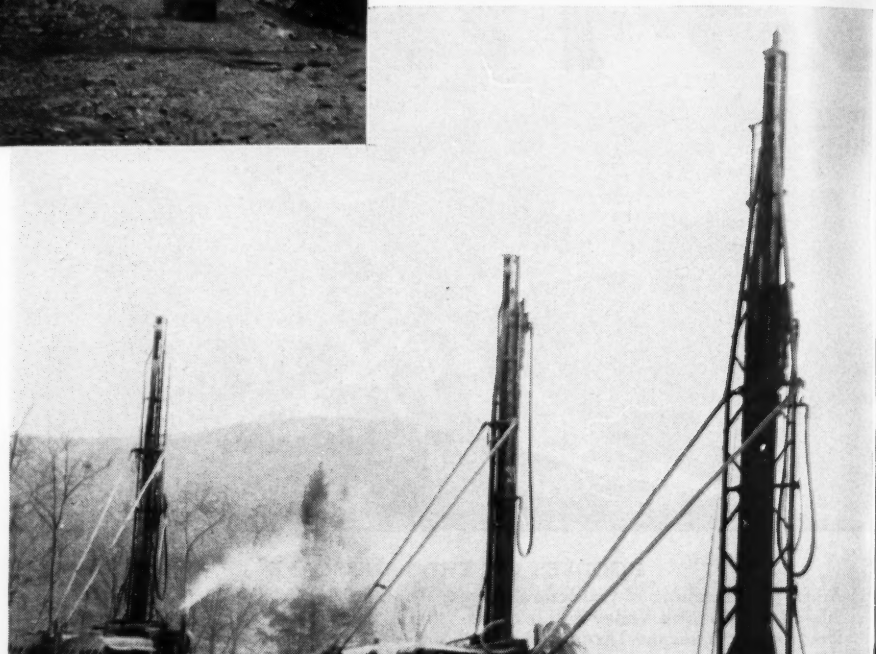
Some 30 miles west of Syracuse and skirting the northern end of Lake Cayuga, 3 miles of the Thruway crosses Montezuma Swamp, a Federal wild-life refuge that is kept under 1 or 2 feet of water by means of dikes and control gates. There, in order to build the road on a stable base, the contractor, A. S. Wickstrom of Skaneateles, N. Y., had to remove from 2 to 10 feet of muck that extended down to a layer of marl and then fill in the space with acceptable "borrow" material.

That was done in 1952 by rearing dikes of impervious earth to divide the area concerned into a series of smaller working plots about 1000 feet long. After pumping out excess water from a sump created by trenching across the center, the muck was removed with draglines and spread outside the dikes. A 2- to 3-foot layer of glacial drift consisting of sand, gravel, stones and clay was next deposited on the marl with light equipment, forming a base on which heavier machines could work. The latter then completed the fill, compacting each layer as it was added and building up the surface to a height of 3 to 7 feet above-grade. This extra weight accelerated settlement essential to providing a stable foundation for the pavement. The surcharge was left in place until the following summer, when it was removed and the paving laid. No settlement has been observed since that time.

Unstable ground also had to be dealt with at a point a few miles eastward where the highway will cross the outlet of Lake Onondaga on a bridge. For approximately 1000 feet to the east and 400 feet to the west of the waterway, the subsoil is soft, spongy marl from 10 to 65 feet in thickness that is incapable of supporting the 23-foot-high embankments for the bridge approaches. The problem was solved by sand drains such as were extensively used on the New Jersey Turnpike where it traverses the swampy "Meadows" section between Newark and the Hudson River.

Two contracts totaling $6,281,174 were awarded in 1952 to D. W. Winkelman, Inc., of Syracuse, N. Y., covering the bridge construction and the drainage project. In the case of the latter, the first step was to spread from 4 to 5 feet of granular material over the area. This served as a working surface for the succeeding operations and as a pervious blanket through which the water later brought up from below could run off to the sides. Vertical holes from 18 to 22 inches in diameter and from 8 to 12 feet apart were punched through the blanket and subsoil to a firm foundation about 50 feet below ground.

The holes were filled with sand and the embankments reared on top of the pervious material. The rate of deposition was controlled by observing the pore-water pressure in the subsoil registered on gauges located at the toes of the slopes and connected with instruments in the interior of the mass. The rate of settlement was also checked frequently by noting the change in elevation of platforms incorporated in the embank-



ATTACKING BIG CUT

These pictures and those on the remaining pages of the article illustrate some of the work being done by Mt. Vernon-Healy-Gammino, contractors on the 12.8-mile section north of Sloatsburg, about 30 miles out of New York City. A partly completed cut from which roughly 900,000 cubic yards of rock will be taken is shown at the top-left with the towers of three Ingersoll-Rand Quarrymaster drills visible in the center distance. These work horses of the hard-rock industry, seen at closer range above, are spearheading the attack. They eat 6-inch holes in the gneiss rock at a rate of 10 feet per hour or more. The view at the top-right shows one of the dulled Carset (tungsten carbide-insert) drill bits being reconditioned with an Ingersoll-Rand air-operated grinder.

ments. Hollow piling for the bridge at this point and for several others on the Thruway were sunk with the aid of a pneumatic mandrel that expands inside the casing and transmits the driving force to the pile by friction. Much of this piling has been put in place by C. L. Guild of East Providence, R. I.

The major Thruway Bridge is the $60 million 2.8-mile-long Hudson River crossing between Tarrytown and South Nyack and a few miles north of New York City. Its main span was originally designed as a tied arch 1112 feet long, but when bids for the construction of the superstructure were asked in December, 1952, none was received. Contractors apparently would not undertake the job at a figure within the estimate of $35,-764,000 set by the Thruway engineers and knew that a bid exceeding that sum would be automatically rejected under a state law.

Rather than increase the estimate, the engineers decided to substitute a cantilever truss for the main span and to divide the superstructure work into several contracts. When this plan was followed, the American Bridge Company was awarded the principal contract for $28,807,092. The foundations for the structure are now being built, and some of the piers will be supported on large floating concrete boxes that were dealt with in our November issue. A delay in obtaining steel for the bridge is now certain and will result in postponing the opening of the Suffern-New York City link of the superhighway until some time next year.

The remainder of this article will describe a Thruway contract that is outstanding because of the money it represents and the quantity of material to be excavated. It covers grading, erecting required structures and paving a 12.8-mile section from Harriman to Sloatsburg, about 30 miles from the southern terminus of the superhighway. The joint venturers—Mt. Vernon Contracting Corporation, S. A. Healy Company, and M. A. Gammino Construction Company, obtained the work on a bid of $17,-440,509, which was nearly $2 million less than the Thruway engineers' estimate. The amount is the largest for any road contract ever awarded in New York State and may also set a record for the nation.

The section in question goes through the valley of the Ramapo River, which is already followed by U. S. Route 17 and the Erie Railroad tracks. Where the valley widens, it will run on or close to the floor. In narrow places it will, of necessity, take to the hillside, and that

LOADING AND DUMPING

One of the sixteen power shovels on the job is seen at the left loading broken rock into a Euclid truck of which a fleet of 72 is in service. The other view shows rear dump Euclids unloading rock blasted by means of holes put down by Quarrymaster drills. It is on this solid foundation that the future roadway will run.

explains why almost 4,000,000 cubic yards of rock and earth will have to be removed, or about one-twentieth of the total for the entire Thruway. The contract also involves building nine grade-separation structures where the thoroughfare crosses existing railroads or highways.

Upon moving in last spring, the contractors began clearing the right of way. Trees of lumber grade were sawed into timber at the south end of the stretch. The next step was to clear away topsoil and stockpile it for use later in landscaping the roadside. This entailed the handling of 600,000 cubic yards of earth. Other preliminary work included diverting the Ramapo in six places where draglines shifted about 150,000 cubic yards of material. The new stream channel is from 35 to 42 feet wide. More than 5 miles of high-tension power lines and many miles of drainage structures also had to be relocated.

By August these operations were completed, or well along, and the job of carving out the right of way began in earnest. Near the northern end of the contract, 200,000 cubic yards of muck and other unstable material was cleared from low ground by two Lima and two Northwest draglines and replaced with rock fill hauled in by trucks. The fill was built up 6 to 8 feet above final grade and the surplus will be left there for six months to consolidate the underlying soft clay base.

The material to be excavated consists of approximately 1.7 million cubic yards of rock and 2,000,000 cubic yards of earth. About 2.5 million cubic yards of it will have to be moved an average of 4 miles mostly from the south toward the north, to fill in low places. Of the remainder, around 500,000 cubic yards will have to be hauled 12 miles. About 25,000 cubic yards is now being handled daily, and this will be increased to 30,000 cubic yards when operations reach their peak.

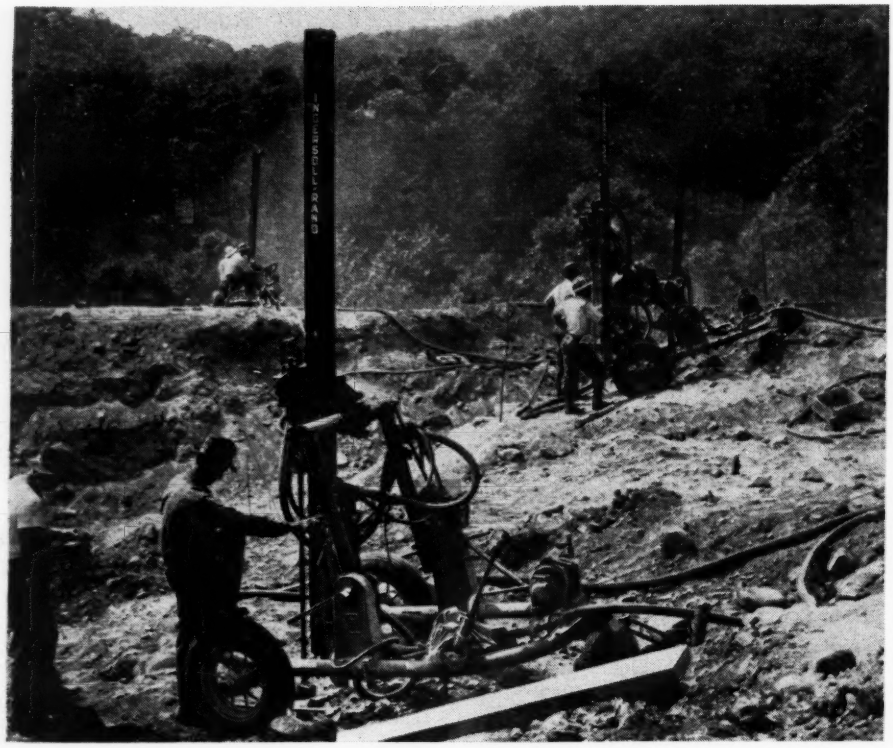
To break up, load, haul and spread this huge chunk of the earth's crust, the contractors assembled around $4.5 million worth of assorted equipment. The attack on the rock is spearheaded by three Ingersoll-Rand Quarrymaster drills that had been used in excavating for The Dalles Dam in Oregon and moved cross country to the present working site. As a matter of fact, two of the rigs had already seen service at Neversink, N. Y., and have therefore made two overland trips. The Quarrymasters are backed by more than 50 smaller machines that include about 40 conventional wagon-mounted units. Sixteen power shovels, ranging from a 2-yard Northwest to two P&H 6-yard models, load the broken material into 72 Euclid wagons and trucks consisting of 39 rear-dump units 10 and 15 yards in capacity and 33 bottom dump units 13 and 25 yards in size. Soft and loose earth is excavated and transferred by thirteen Caterpillar and LeTourneau scraper and pan-type loaders.

For various pushing, pulling and leveling chores there are on hand 24 tractors and tractor-dozers, mostly of Caterpillar make. By modifying the engines of twenty of the latter their horsepower has been increased from 130 to 163 and the vehicles' speed by 20 percent. This involved making changes in the air intake, air filter and exhaust and stepping up the engine from 1000 to 1200 rpm. The added speed thus obtained makes a big difference in a day's haulage of material. Most of the fill is consolidated with tractor-drawn sheep's-foot rollers.

Approximately 900,000 cubic yards of rock is being removed from one huge cut where a spur of the mountain range stands squarely in the path of the Thruway. It is about ¼ mile long, 95 feet deep and 160 feet wide at the top and 125 feet at the bottom; in short, a sizable quarrying operation. When the job was visited in late November, the three Quarrymasters were working close together there. Forty or more feet of rock had been taken out at the high point and 27 feet remained to be excavated. There, as elsewhere, the rock is a moderately fine-grained gneiss that is comparatively free from joints or fractures. It is blue when first broken, but turns gray after weathering.

The big 35-ton rigs were putting down 30-foot holes with 6-inch Carset (tungsten carbide-insert) bits at a rate of about 10 feet per hour, including moving, and this was reported to be their average performance since they went to work last August. Holes were being spaced 12 feet apart in each direction, this figure having been arrived at as most favorable for the explosive to break the rock into large pieces but not too large to be handled by the 6-yard shovel that was loading it into trucks. Previously, 11-foot spacing had occasionally been tried.

At that time each bit was drilling around 90-100 feet, or roughly the equivalent of a day's work, before it needed resharpening and was reconditioned an average of ten times before it was discarded. Some bits have drilled close to 1500 feet. The Quarrymaster holes are loaded with Du Pont Nitramex in 4½ by 24-inch containers holding 22 pounds



WAGON DRILLS

On this $17-million job, approximately 40 wagon-mounted drills and some smaller hand-held types are supplementing the big Quarrymasters. The machines pictured drill 2-inch holes 30 feet deep.

each, the charge amounting to about 160 pounds per hole.

Wagon drills supplement the Quarrymasters especially on hillsides that can't be negotiated by the larger machines, or where the burden of rock is not great enough to require their use. Some of the terrain is so rugged that guy lines have to be run uphill to a tree or protruding rock to keep the wagon drills from hurtling downward. Isolated ledges and other projections, where there is not sufficient room or where the footing is too precarious for wagon drills, are attacked with hand-held machines. The spacing of the wagon-drill holes varies with the formation. In the big cut they are being put down on 4-foot centers and carried 30 feet deep, with four steel changes. Two-inch tungsten carbide-insert bits are utilized, and blasting is done with 60 percent dynamite in 1½-inch cartridges.

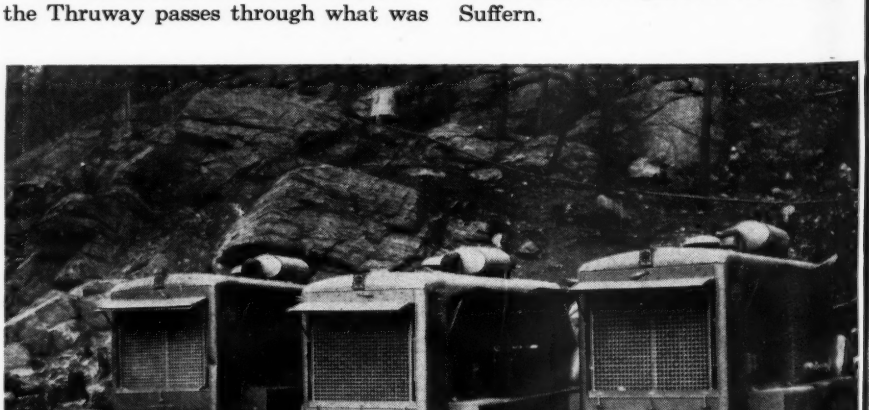
This job has a central air-compressing plant, which is somewhat unusual in this day because portable compressors are mostly used on temporary work of this sort. The main reason for such an installation is, of course, the enormous amount of drilling that has to be done. Six motor-driven, 2-stage units produce approximately 6000 cfm of air at 100 psi pressure. It is distributed both ways along the route through about 5300 feet of 8-inch Naylor spiralwelded pipe. In order adequately to serve the big cut, which is only a few hundred feet from the compressor plant, lines are run on both sides. The Quarrymasters draw no air from this source because each one carries two 415-cfm compressors. For service beyond the ends of the pipe lines there are eleven portables with an aggregate capacity of about 6500 cfm. Altogether, it is possible to compress around 15,000 cfm of air, which is perhaps a record for a single roadbuilding contract.

The Sloatsburg-Harriman section of the Thruway passes through what was once called the social center of America. At Tuxedo Park, 3 miles above Sloatsburg, Pierre Lorrillard, the fourth, created a 13,000-acre estate in the 1880's and persuaded wealthy and socially prominent New Yorkers to buy property in the neighborhood, his idea being to make it a mecca for millionaires. It was there that the Tuxedo dinner jacket got its name and Emily Post, the arbiter of social customs, once lived.

The contractors' main office at Arden, near the northern terminus of the job, is in a building that formerly housed the office of a dairy on the estate of E. H. Harriman, former railroad magnate. Close by is a well-preserved charcoal furnace that is said to have produced pig iron until around the Civil War period. The Harriman holdings at one time comprised 20,000 acres with a 150-room chateau on a mountain top. Of this domain, Mr. Harriman willed to New York State a tract of 10,000 acres now known as the Harriman Section of Palisades Interstate Park.

Numerous domestics, gardeners and other servants were attracted to the estates in their heyday, but as the larger properties were broken up, need for them diminished. As a result, the village they had established in the valley deteriorated, and its shabby appearance contrasted sharply with the evidences of wealth in the surrounding hills. The hamlet, which is known as Italian Village, is being cut through and decimated by the Thruway. Many of its run-down structures have been moved away or demolished.

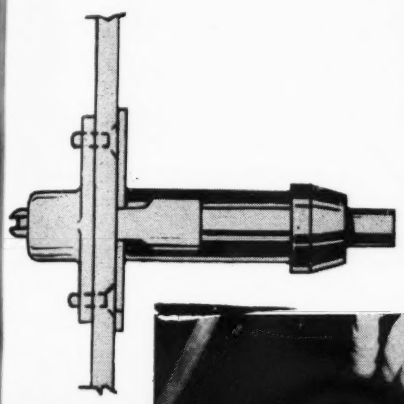
South of the contract described, the Mt. Vernon-Healy-Gammino combination is building a 1.9-mile section of the Thruway on a bid price of $10,044,781. It includes a complicated interchange at Suffern.

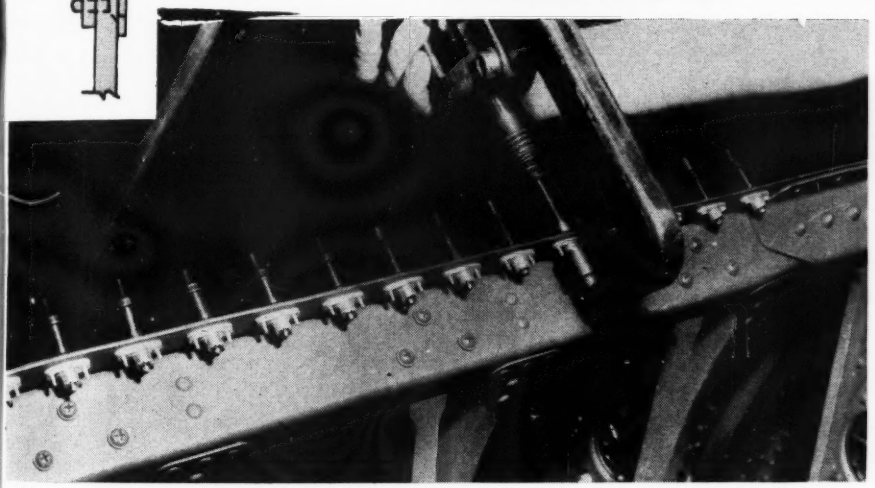


SOURCE OF AIR

In addition to six stationary compressors, the contractors are drawing on portable machines for their supply of compressed air. Shown are three Ingersoll-Rand Gyro-Flo rotary units that deliver 600 cfm each.

Two New Air Tools Speed Aircraft Production





RIVET UNIT AND FASTENERS

The parts projecting above the anchor-nut plates are the spring fasteners which make it possible to place plates and rivets in advance of riveting because they cannot fall off or be jarred loose during that operation. There are two types of fasteners: one with a straight shaft-like pilot and the other with a semiconical or taper pilot. Details of the anchor-nut plate with attached fastener are shown above.

PUNCH UNIT IN OPERATION

The large center hole is the pilot hole which indexes the positioner on the punch and is also the opening for the bolt to be threaded into the anchor nut. Controls for the tool are side-mounted for ease of handling.

IN AIRCRAFT and allied industries, the work of drilling two rivet holes for attaching various sizes and types of anchor-nut plates has long been a production problem because both the diameter and pattern spacing of the holes are critical dimensions that must be held within close tolerances. Sometimes the operation is further complicated by the physical characteristics of the material being worked; stainless steel, for example, requires specially ground bits and slow-speed drilling motors.

Anchor-nut plates are nuts with flanges that are drilled to receive rivets. They are put in position on access panels of airplane fuselages and similar parts located where it is difficult or impossible for a wrench to hold the nuts for tightening. The plates must be placed with precision so the nuts will line up with holes in the panel through which machine screws or bolts are to be threaded.

In order to perform the operation with facility, the Wedgelock Company of North Hollywood, Calif., has developed a compact, pneumatically powered tool that will simultaneously punch two holes conforming to the rivet pattern of any given plate. Called the Wedgelock Punch Unit, it is attached to an Ingersoll-Rand Model AR-130 Air-Buck Riveter that provides the impact force necessary to run it. Although small and light (16 inches long and weighing 13 pounds together with the riveter) the tool will punch two No. 40 holes with ease in aluminum alloys as much as ⅛-inch in thickness. A high-strength steel yoke with built-in dies is used to back up the punch.

The operating cycle of the unit involves indexing a spring-loaded pilot into a pilot hole in the material; depressing a throttle partway to bring the two punches to bear on the work; and keeping the throttle fully depressed until the holes are driven. Even with the throttle entirely open, the ram of the Air-Buck Riveter returns to the starting point upon completion of the cycle, and full release and depression of the throttle are necessary to repeat the performance. Should the actuating lever be opened accidentally without work between the punches and the dies, the ram will travel down and then retract automatically without functioning, a safety feature that prevents damage to the tooling.

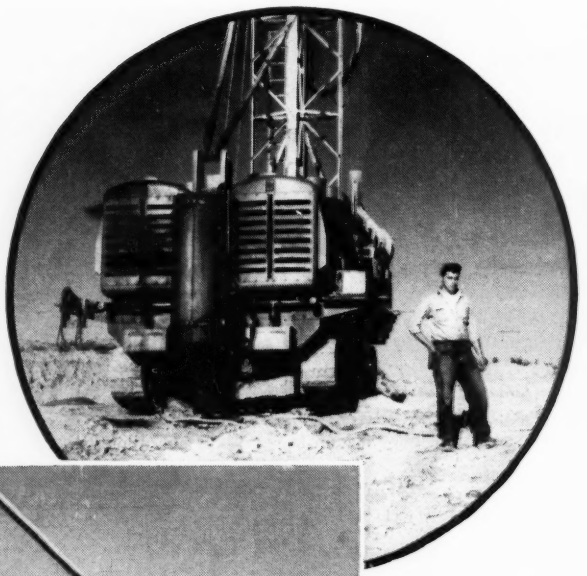
The Air-Buck Riveter is designed to deliver 1725 blows per minute and has the power to upset aluminum rivets ¼ inch in diameter. Originally designated as the AR-13, the tool was improved and modified to meet the needs of the punch unit and received the number AR-130.

A companion device is the Wedgelock Rivet Unit that upsets the two rivets at one time. It is used with a fastener designed by the company to hold the anchor-nut plate in place during riveting. Incorporated in the fastener is a spring loading device that facilitates attachment and removal, thus eliminating the slow procedure of securing the plate with small screws or other means. The rivet unit, which is also served by an AR-130 Air-Buck Riveter, has a cutaway drive set into which the fastener slips. The sequence of the upsetting operation consists in putting the anchor-nut plate in position, inserting the rivets, snapping the fastener in place and tightening the rivets. The tools have greatly speeded up the work because they automatically position themselves without the use of jigs and gauging devices.

Barvue Zinc

THE MINE THAT STARTED BIG

Allen S. Park



PHOTOS FROM MINING WORLD AND CANADIAN MINING JOURNAL

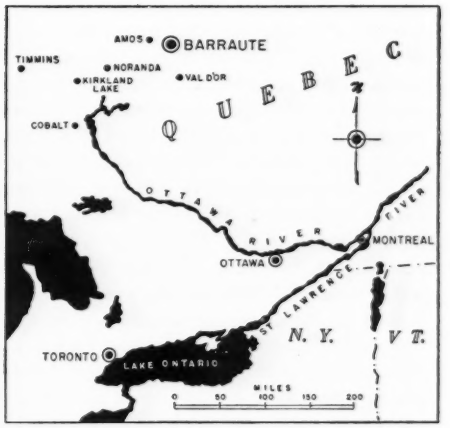
MOST metal mines start on a small scale, and the few that eventually get big attain stature gradually. So the case of Barvue Mines Ltd., in Canada, is extraordinary. This large open-pit operation sprang from grass roots to full-blown production in just about 30 months. During the intervening period the ore body was prospected, outlined and appraised by diamond drilling; approximately a million cubic yards of overburden was removed; a 4.2-mile service railroad was laid and power lines were strung; mining equipment was brought in and began to work; a complete concentrating mill was designed, erected and broken in; and a townsite was laid out and developed with living facilities for operating staff and employees. The bill for all this exceeded $11 million and was met before a pound of ore was treated.

Such a thing probably wouldn't happen in normal times. The schedule was speeded up because Barvue is essentially a producer of zinc, a metal that was in demand owing to the Korean situation and the international armament race. As soon as bore holes had revealed the existence of a large ore deposit, the company contracted to deliver 175,000 tons of concentrate to the American Zinc Company at a rate of 6000 tons per month. It will receive 17.5 cents per pound for the zinc content. This amounts to a $61,250,000 order and will require the mining and processing of around four million tons of ore.

The property is located near the village of Barville in Barraute Township, northwestern Quebec, about 37 miles from the town of Val d'Or and roughly 75 miles northeast of the well-known Noranda mining district. It is equipped to produce and mill up to 6000 tons of ore a day, a figure that ranks it as the largest "initial" nonferrous mine in Canada and the largest base-metal mine in Quebec. Actually, the operating rate is maintained at around 5000 tons daily, which will comfortably meet contract requirements. This pace yields four car-

HEAVY-DUTY DRILLING

Nature kindly put the multimillion-ton ore deposit close to the surface where it can be mined economically. These pictures show the beginning of what will eventually become a vast open pit, roughly 3000x300 feet in extent at the surface. To supply the mill with approximately 5000 tons of ore per day, two Quarrymaster drills are putting down 6-inch blast holes 30 feet deep at a rate of about 12 feet per hour. These completely air-operated, 35-ton machines can readily move around under their own power and also carry their own air supply—two specially built 415-cfm, diesel engine-driven compressors that discharge at 130 psi pressure. It is expected that the upper 285 feet of the ore body can be extracted by open-pit methods, after which underground mining will have to be adopted.



LOCATION MAP

loads (200 tons) of concentrate containing from 60 to 61 percent zinc and 15 to 20 ounces of silver per ton.

As recently as the fall of 1950, the site was a level expanse of farmland and muskeg. In that year, Dr. W. W. Weber, then with the Quebec Department of Mines and now staff geologist for Barvue, noticed and reported a showing of zinc-bearing mineral on an outcrop of rock near the property that has developed into the Barvue Mine. He expressed the opinion that it was worth prospecting. Two brothers, named LeClerc, who held the adjoining mineral claims, followed the advice of Gaston Lavalle, a prospector trenching close to an outcrop that is near the center of the present Barvue pit footwall. This divulged a high-grade stringer of ore, but there was too much overburden to determine what was farther down. The LeClercs optioned the property to New Goldvue Mines, Ltd., which, in turn, transferred it to Golden Manitou Mines, Ltd., a large base-metal producer located about 45 miles away. The latter agreed to spend at least $100,000 in prospecting the showing and formed Barvue Mines Ltd to do that.

Diamond drillers moved in and put down 54 successive holes in ore, most of them in a straight line and about 50 feet apart. This probing and sampling indicated that the deposit is about 2500 feet long, 102 feet in average width and dips at an angle of around 76° in the enclosing rhyolite-breccia country rock. It is apparently as large 700 feet down as at the top. How much farther it extends is not known, because no drilling was done below the 700-foot horizon. During freeze-up on account of icy roads the cores were flown to the Golden Manitou property for assaying and showed an average mineral content of 3.12 percent zinc, 0.94 ounce silver, 5 to 7 percent pyrite and a small quantity of arsenopyrite. It was calculated that approximately 17.5 million tons of this grade exists down to a depth of 700 feet.

Although the ore was classed as low grade, there was so much of it that the engineers visualized a paying venture at the predictable average future price of zinc if a large-scale operation could be set up. They consequently made tentative plans for a 4000-ton daily output, and this amount was subsequently increased. That was in the summer of 1951, and in the following January the first concrete for the mill buildings was poured. Stripping of the overburden had then been underway for two months. In January, also, a spur railroad reached the site from the Canadian National main line, and a few months later 500 men were at work and thousands of tons of freight were pouring in. In October, 1952, the mill was started.

The clay mantle, of glacial origin, was washed away with water under pressure for around 34 cents per cubic yard, which was only a fraction of the estimated cost of doing the job with draglines and trucks. A centrifugal pump driven by a GM diesel engine was set up half a mile away on the LaFlamme River and delivered water to a reservoir near the deposit. From there another centrifugal, similarly powered, pumped it under 125 psi pressure to 6-inch monitors. At times up to three nozzles were in service and each directed 1350 gpm against the deposit, which ranged from 1 to 30 feet in thickness and averaged about 17 feet. The water and sediment, running from 25 to 35 percent solids, flowed to a sump and was delivered from there through a 16-inch wood-stave line to a nearby swamp that is now serving as a tailings pond for the mill. All told, an area of 3000x300 feet was cleared. Up to 105,000 cubic yards per month was removed.

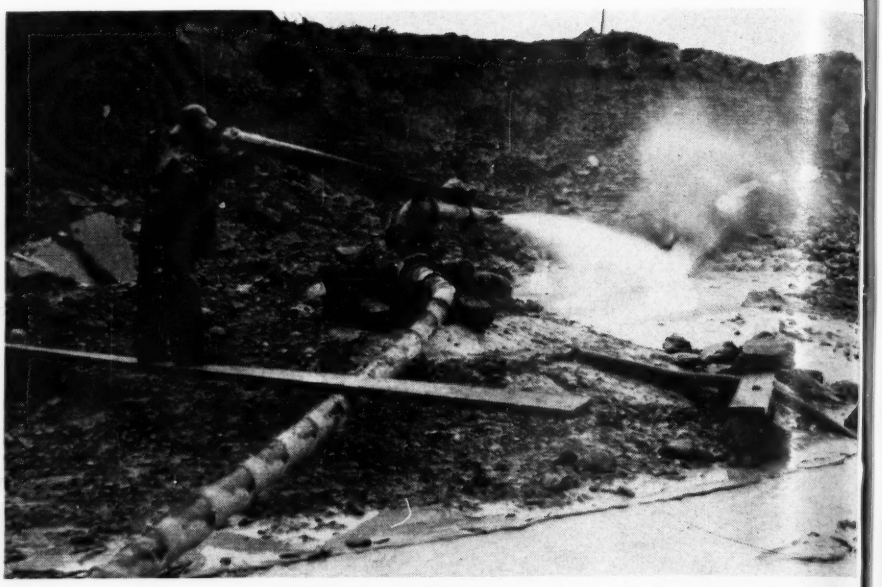
The southeastern section of the site was attacked first, and as soon as enough of the ore body had been laid bare, preparations were made to begin mining. Meanwhile, the construction program was moving ahead rapidly. To save time, sectional prefabricated steel frames were used wherever possible. They were produced in England and shipped knocked down. The larger structures and major units of the plant equipment were fabricated and erected by the Central Bridge Company, Trenton, Ont., and represented standard steel construction procedure.

The ore body will be worked in a series of benches approximately 30 feet high, and sections of three of them have already been excavated, creating a small pit with a maximum depth of 90 feet. Primary drilling is done by means of two

Ingersoll-Rand Quarrymasters, self contained, air-operated machines that can move about under their own power. Using 6-inch Carset (tungsten carbide-insert) bits, they can penetrate the medium-hard zinc-sulphide zone at a rate of 12 feet per hour, while the footage in waste is approximately 18 feet. These rates of penetration include moving and maintenance time. The over-all cost is less than $1 per foot of hole. Drilling is done dry, and this averts trouble that would result if water were used in the subzero winter temperatures common to the region. Holes spaced about 16 feet apart are loaded with 40 percent Forcite blasting powder in 5-inch cartridges and fired with Primacord and micro-delay detonators.

Broken material is loaded by two Link-Belt 2½-yard shovels and one Marion 4-yard into Euclid 22-ton trucks and hauled to an 800-ton feeder bin over a 48x60-inch jaw crusher installed 80 feet underground. Pieces are reduced to 7-inch maximum diameter and conveyed to a 6000-ton surge bin from which a second conveyor delivers them to one 7-foot and two 5½-foot cone crushers. The fine ore is deposited in an 8000-ton mill bin that insures feed there for around 40 hours to overlap week ends and holidays. Final reduction to 67 percent –200 mesh is effected by four Hardinge Tricone 11-foot ball mills, and in this fine condition the material is fed to Agitair and Denver Sub-A flotation machines.

The present object is to save the zinc and silver only, and the selective flotation process is arranged accordingly, with pyrite and arsenopyrite being rejected. To guide the mill operators in controlling the quantities of reagents introduced and the alkalinity of the circuit to produce a concentrate containing 60 percent or more of zinc, the zinc and iron content at key points is assayed every three hours. After more experience has been gained, it may be possible to install automatic controls.

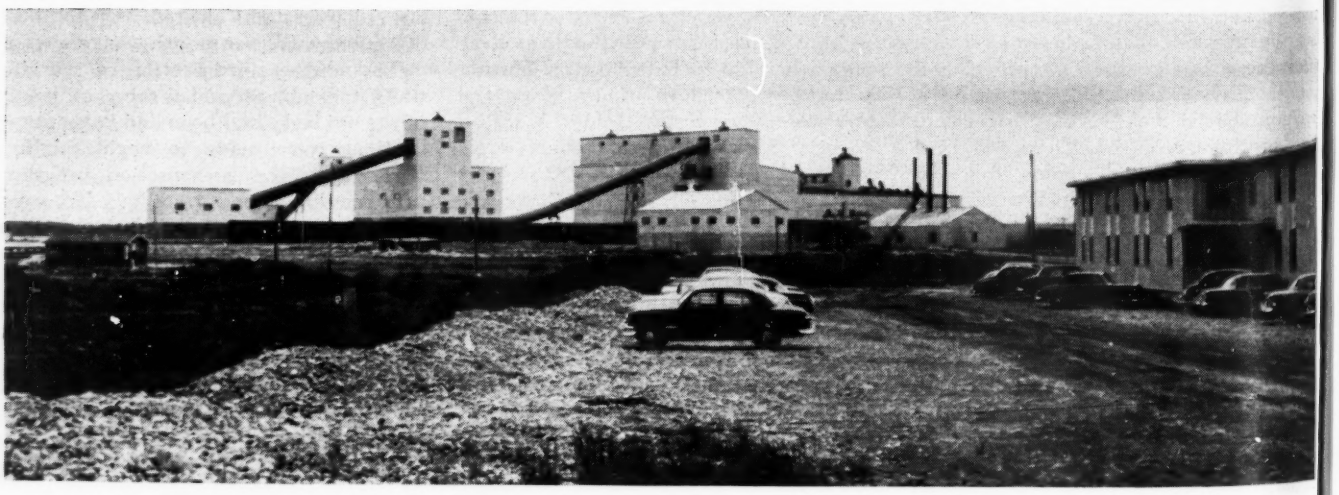


SLUICING OVERBURDEN

When the ice sheet retreated it left a layer of earth, mostly clay, ranging from one to 30 feet in thickness on top of the ore body. Barvue engineers figured out that this could be washed away much cheaper than it could be hauled away. Water from a nearby stream was put under 125 psi pressure and directed through monitors that were maneuvered so as to dislodge the material. The slurry flowed into a sump from which it was pumped to a disposal area. About one million cubic yards of earth was removed at an average cost of 34 cents per cubic yard.

Despite the speed with which the mill was built, it is well constructed and embodies some of the most modern ideas in the field. It was designed by General Engineering Company, of Toronto, and by David Livingstone, Golden Manitou's staff metallurgist. To thwart northwestern Quebec's severe winter weather and gumbo clay, all the main structures are connected by 2350 feet of underground tunnels that carry compressed-air and water lines, electrical cables and other utilities, thus safeguarding them against the effects of cold as well as the concussions of blasts in the pit and making it easy to work on them. The galleries are of three sizes: 7 feet wide by 9 feet high, 6x7, and 3x6, and all can be used as walkways.

The main concentrator building has a ground area of 120x300 feet and is supported on concrete piling driven through the surficial layer of clay to bedrock. It is constructed of concrete and steel with asbestos siding. As steel was hard to get at the time, 300 tons was obtained by taking over the mill building of the former Uchi gold mine. The concentrator structure is serviced at all levels by a push-button elevator large enough to carry a loaded lift truck. This virtually

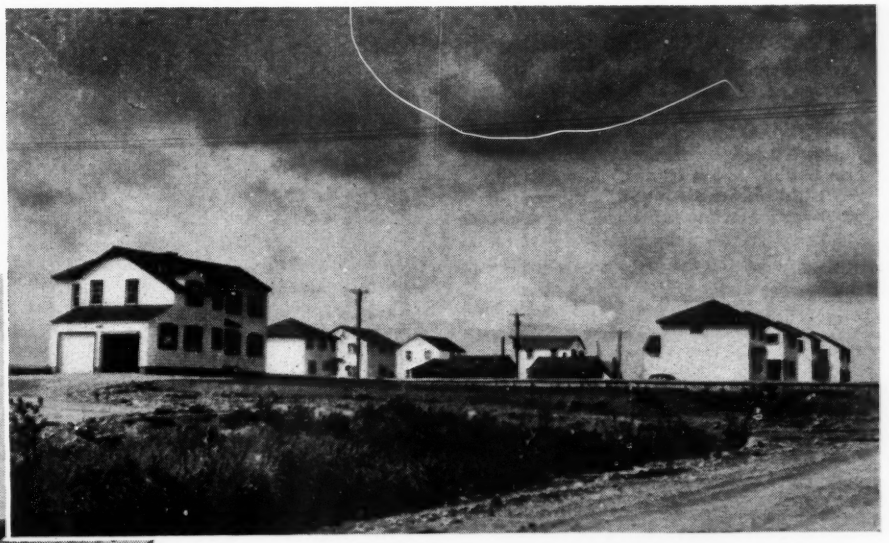


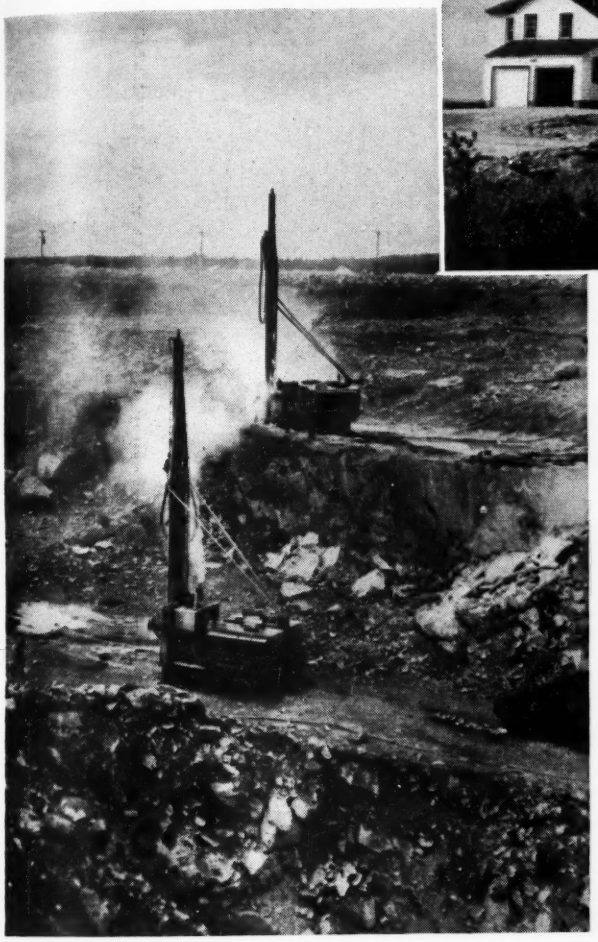
CONCENTRATING MILL

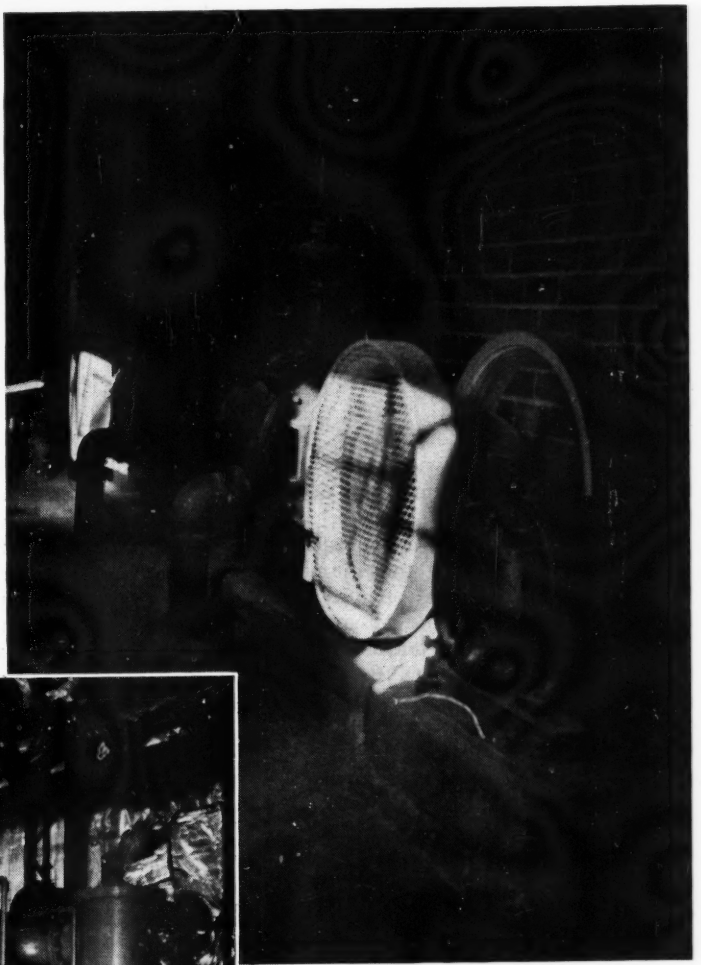
General view taken last July. The two structures at the left are the primary and secondary crushing plants. Material is carried between them and on into the flotation mill in the center by conveyor belts housed in pipes 10 feet in diameter. Service buildings stand in front of the mill, and the bunkhouse for single employees is at the right.

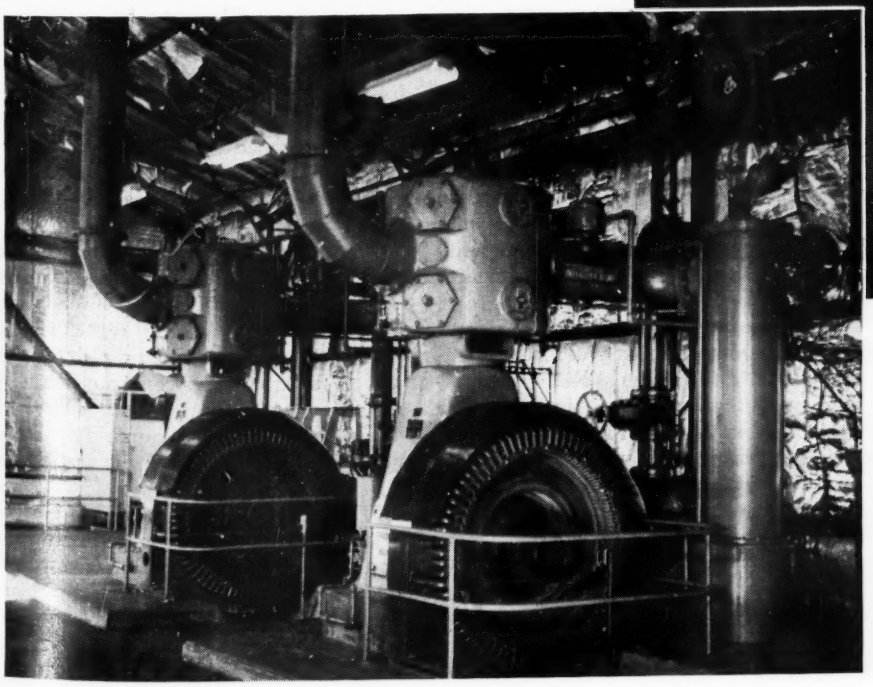
TOWNSITE

Although their location is somewhat remote, the staff and employees live in attractive, substantial and comfortable houses such as those pictured at the right.









IN MINE AND MILL

At the upper left is a recent view of the Quarrymaster drills working on different levels in the rapidly developing open pit. The rigs carry their own air supply, but other needs for compressed air around the mine and mill are met by the two Canadian Ingersoll-Rand 1500-cfm compressors shown at the left. One of the final steps in milling is to extract moisture from the concentrate. This is accomplished by a vacuum-type filter served by the two CIR 22x9-inch suction pumps pictured above.

BLASTING AND LOADING

The detonation of approximately 15,000 pounds of 40 percent Forcite resulted in the blast pictured below and shattered 30,000 tons of ore. Broken material is loaded by three power shovels into Euclid 22-ton trucks. The view at the right shows an electrically operated 4-yard Marion in action.

eliminates manual handling of supplies. The reagents for the flotation machines are hoisted to the top floor whence, mixed with water, they flow by gravity to distribution tanks and from there to the various points of use.

The conveyors that carry the crushed ore are enclosed in 10-foot-diameter pipes made of ¼-inch steel plate and have enough strength to be self-supporting everywhere except on one or two long stretches between buildings. Both tubes and conveyors were fabricated in sections of convenient size for shipping and then put together in the field in much shorter time than would otherwise have been possible.

Another modern touch is an 8000-ton storage bin for fine ore interposed between the crushing and the flotation facilities. Of the "catenary" type, it is suspended from posts at the sides and is entirely inside the mill building where warm air can circulate around it. It has 24 draw-off points along the bottom. Its construction entailed the welding of approximately 25 miles of joints.

The crushing equipment has a capacity of 500 tons per hour, and in addition to handling ore will, at times, reduce waste rock from the pit to sizes suitable for surfacing haulage roads and thus keeping them in good condition during wet-weather periods. This material will be crushed to ½-inch size and stored in its own bin for withdrawal into trucks as needed.

As the first few months of operation was spent in getting the mine and mill up to scheduled production, little attention could be given to improving the proportion of zinc recovered from the ore and to reducing over-all costs. However, considerable progress has been made along both lines, and they are now being more closely studied. Up to last May approximately 85 percent of the contained zinc was being saved in the concentrate. It is expected that it will soon be stabilized at 90 percent or higher.

Every 1 percent improvement in recovery will add about $7000 to the monthly profit. The total operating cost, which ranged close to $3 per ton at the outset, has been gradually reduced and is now below $2. In May the figure was $1.82—made up of around 81 cents each for mining and milling and 20 cents for overhead charges. The current aim is to firm the cost at $1.75 per ton.

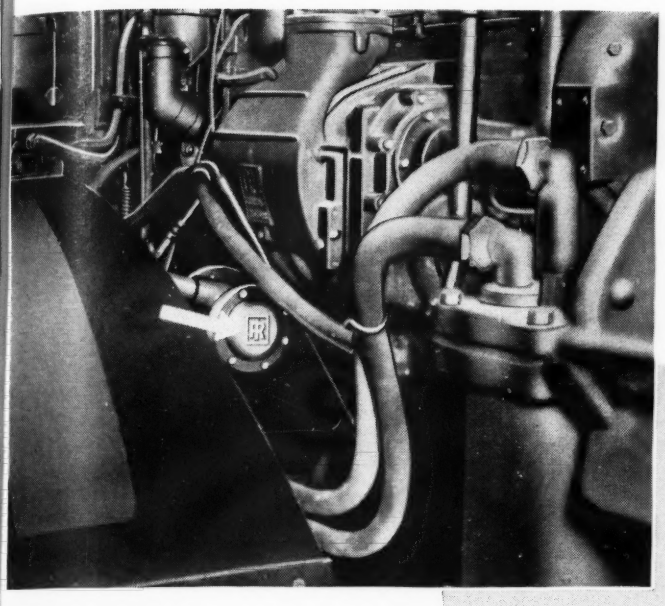
The concentrate is shipped by rail to the Aluminum Company of Canada refinery at Arvida, Que., where the sulphur, which is used for making sulphuric acid, is removed by roasting by Dorr Company's fluo-solid process. The residue, zinc calcine, is then transported to zinc smelters in the United States. The immediate purchaser is the American Zinc, Lead & Smelting Company.

Barvue's future will naturally be affected by the price of zinc, which toppled after the Korean emergency had passed. Currently, and for at least two more years, a good profit is in store at the favorable contracted price. Enough ore to fill the contract can easily be taken out by open-pit operations. It is believed that the pit can be carried down about 285 feet, after which underground mining will have to be adopted. Tentative plans have already been made to sink a 5-compartment shaft to give access to the lower part of the ore body. It is estimated that underground operation will add about 50 cents a ton to the cost.

Half a mile away from the mining area is the townsite, with housing and shopping facilities, schools, playgrounds and other essentials. The dwellings include company-owned individual homes, 4-family duplexes, a 92-man bunkhouse with cookery and a staff house for single men.

Electric current for the operations and the town is brought in by a line from the Quebec Hydro-Electric Power Commission system. Before it was available, up to 3000 hp was generated by diesel-driven units to keep construction going at full speed. Water is pumped some 2 miles from the LaFlamme River and filtered. About 4000 gpm is used in the mill and 200 gpm for domestic purposes.

H. W. Knight is president of Barvue Mines Ltd. In direct charge of planning and development has been Andrew Robertson, vice-president and general manager. Douglas Isbister is mine manager, A. A. Almstrom is mill superintendent and S. S. Teal is pit superintendent.



Pneumatic Crank

AIR STARTERS FOR DIESEL ENGINES

Copeland Lake

ORE CARRIERS

The 34-ton-capacity Euclid trucks shown above were waiting to be loaded at an open-pit iron mine on the Mesabi Range. Each is powered by two General Motors 200-hp diesel engines. The engines are started by air motors run from the compressor that furnishes air for the brakes. The small amount of room a cranking motor occupies is evident from the picture at the left.

COMPRESSED air is taking on another "muscle" job—the starting of diesel engines. At first it performed this service only for stationary engines and a few propulsion units on tugboats and other small vessels, but during the past three or four years there has been a trend towards using air power on diesel-driven trucks. Hundreds of air motors are already doing this work dependably and economically, and others are replacing conventional electrical cranking systems in growing numbers.

It is the kind of chore for which air-actuated devices are admirably suited. Both cold and heat are hard on electrical units, but air motors are virtually immune to their effects. Automobile owners know full well that batteries are liable to go dead suddenly on one of the first days of winter, and that is one of the main reasons why air starters are becoming popular for diesels that operate outdoors. Other outstanding advantages are low initial cost, low maintenance charges, light weight, and the capacity of air motors to withstand the continual jostling and generally rough treatment to which mobile equipment is inevitably subjected.

Although they are only now coming into considerable use, air-driven starting motors are by no means new. In 1930, Ingersoll-Rand Company furnished a piston-type motor for cranking one of its diesel engines utilized for generating power in a lighthouse at Montauk on the eastern tip of Long Island, N. Y. A few others were supplied for similar work in the following years, but the application did not begin to attain importance until the concern produced a rotary-type motor that was better adapted for the service than the piston model.

In the fall of 1949 two of the rotary motors were mounted on the 300-hp Cummins diesel engines used for powering two 22-ton trucks hauling iron ore from open-pit mines on the Mesabi Range in Minnesota. That was in the nature of a test arranged through the collaboration of Ingersoll-Rand, the M. A. Hanna Company which operates the mine, and the Euclid Road Machinery Company builder of the trucks. After two years of successful performance under rigorous conditions, the motors received the approval of the mining company, which has adopted them for many of its large haulage units.

It was, in fact, the continual and as yet unabated increase in the size of diesel-driven "off-the-highway" vehicles of this sort that called attention to the need for better starting equipment. Up to around 1937 most of the large iron pits were served by railroads. As the workings grew deeper and the grades steeper, the first heavy-duty trucks appeared. They had 15-ton bodies and were powered by 150-hp diesel engines, which were soon increased to 200-hp by adding superchargers. In 1944 twenty-ton bodies and 275-hp engines were introduced, and four years later one mine

In the *Mining Congress Journal*, March, 1953, Charles A. Lindberg wrote regarding winter operation of trucks in the Minnesota iron region:

Air Starters Save Money

"As equipment sizes have gone up, there have been corresponding increases in the size and capacity of the electrical starters, generators, batteries and accessories required. This has grown to a point where the initial investment in accessories and the upkeep have become excessive and out of line. Substantial reductions in both of these have resulted from a change to air starters for the large diesel engines and to relatively small 6- or 12-volt generators and batteries to handle the accessory and lighting load."

added some twin-axle, 30-ton units driven by two 190-hp diesels. Now a 50-ton truck powered by two 300-hp engines is being tried out.

In 1951 trucks moved 84 percent of the 104 million cubic yards of overburden stripped from the Minnesota mines and 64½ percent of the 74½ million tons of ore that was extracted. Large loading and haulage equipment is definitely favored because of its economic advantages and will undoubtedly prevail. For instance, it costs about 16 percent more to operate a 30-ton truck than one of 20-ton size, but the bigger one carries 50 percent more payload.

Large trucks, however, pose problems, and one of them concerns electrical starting. A passenger car is adequately served by a 6-volt battery, but a large truck is apt to have a 24- or 32-volt system and may have as many as four batteries. This source of current is necessary primarily to operate the engine starting mechanism. A 24-volt battery weighs around 100 pounds and is sometimes installed at a point about 8 feet above the ground. The difficulty of replacing or servicing it can be realized. The temperature on the Minnesota iron ranges runs from 110°F in summer to minus 30° in winter. On an extremely cold morning even multiple batteries of high voltage are sometimes not equal to the starting operation. Furthermore, high-voltage current is hard on the fragile headlight lamps, and on one working, alone, 1200 sealed beam lamps were replaced on 170 trucks in a 6-month period.

AIR FROM SHOP LINE

When an air-started truck has been laid up for some time for maintenance or repair and the engine is cold the air receiver can be filled from a shop air line by making an easy connection, as shown.

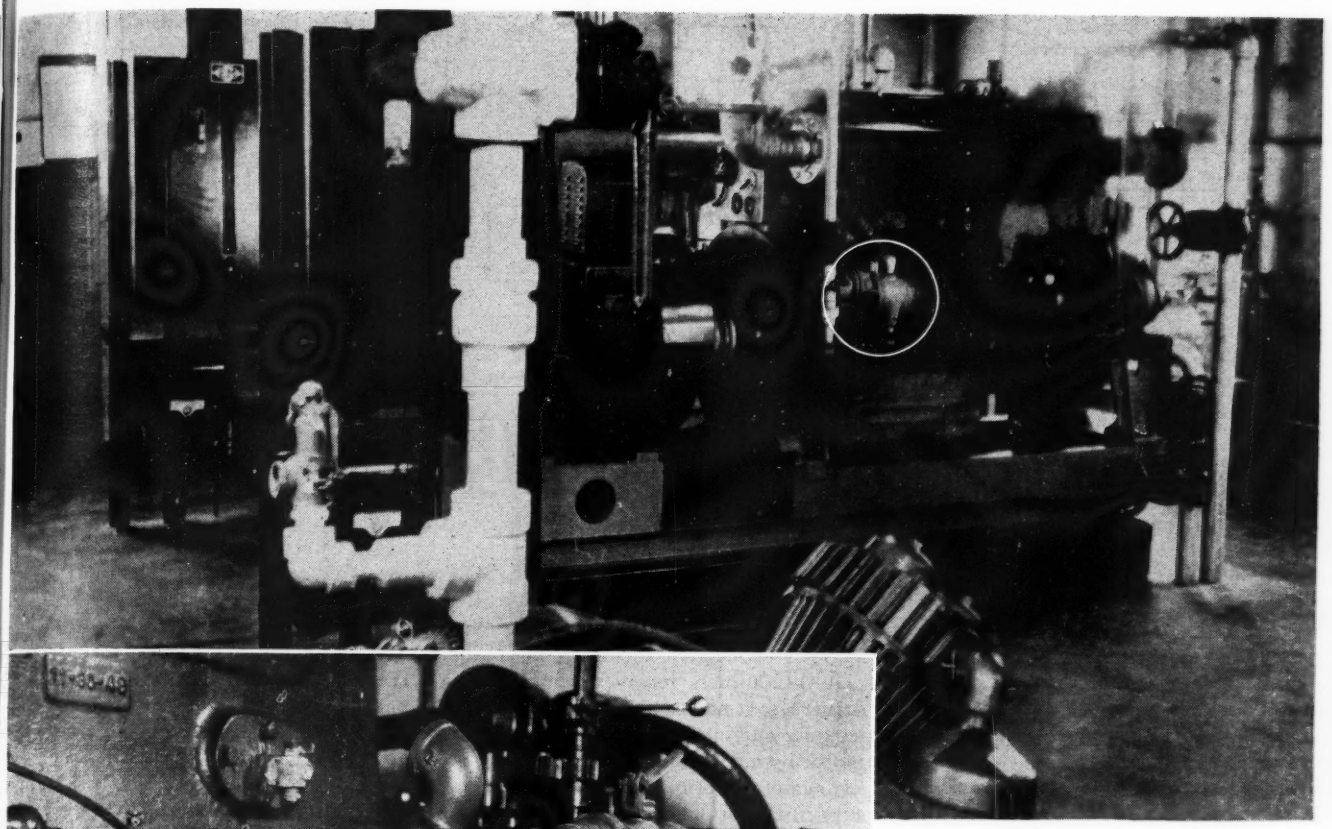
When an air-starting system is put in, the only electric equipment needed is a 6-volt battery similar to a passenger-car unit and a small generator to service the lights. This eliminates all but a small fraction of the former battery maintenance and replacement costs, an item that runs as high as six cents an hour, according to some reports. Reducing the battery voltage also minimizes the fire hazard in case of an accident and does away with the likelihood of battery overcharging. The total saving attributable to air starters on the Mesabi Range trucks has been computed to run as high as 70 percent. It is normally sufficient to pay for the air starting system in one year of operation.

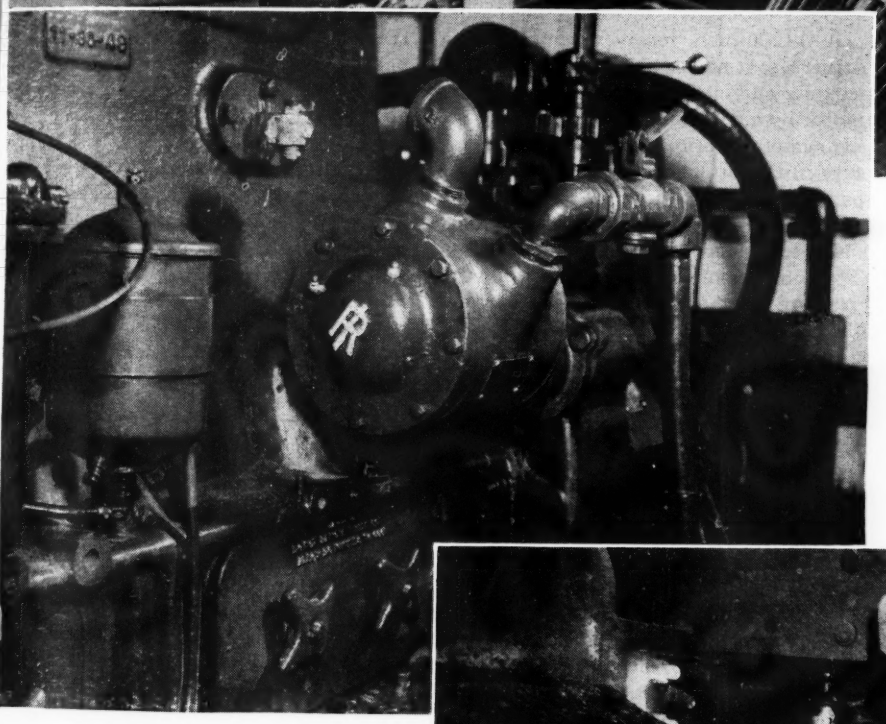
The first "over-the-highway" vehicle to be provided with an air starter was a truck in the fleet of Akers Motor Lines, Inc., which operates more than 300 tractors and nearly 600 trailers in a territory ranging from Macon, Ga., to Boston, Mass. It was applied to a 200-hp diesel engine, and, as in the case of the initial Mesabi installation, was arranged as a test. The change from electricity to air eliminated around 200 pounds of equipment, thus making it possible to carry that much more pay load. That amount of additional cargo can increase revenue by as much as $500 annually. The air system also appears to be a money saver when it comes to maintenance and replacements. The line's cost for these items with electrical starting is pretty well established and averages about $252.50 per year, whereas the air starter, plus a 12-volt battery and accessories to serve lights, can apparently be kept in good working order for approximately $100.00.

Putting an air starting system on a truck or any large haulage unit used in the construction industry does not re-

HIGHWAY TRUCK

One of 55 new Mack cab-over-engine trucks equipped at the factory with air-starting motors and sold to Carolina Freight Carriers. The cab tilts forward to expose the engine. Use of air motors instead of batteries for starting reduces the weight—increases the payload—and gives each vehicle several hundred dollars a year more earning power.



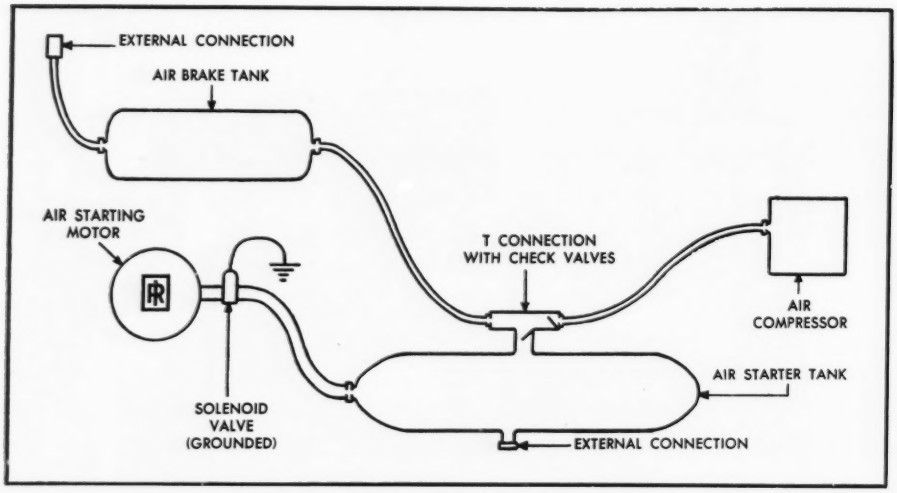


ON LAND AND SEA

The starting motor circled in the picture at the top is mounted on a Waukesha engine in service in a western natural-gas field. The one in the view at the left is on a Buda engine aboard the tugboat "Captain George" of the George Bacon Towing Company. A third one is shown below. It cranks the diesel engine of an International tractor-mounted loader.

quire buying and installing an air compressor because such vehicles already have one as part of their braking equipment. On most trucks this is a Bendix-Westinghouse 12-cfm compressor that is driven off the main engine. Auxiliaries include a small air storage tank, piping to the brakes and the necessary valves and controls. None of these is disturbed when an air starter is added, and conversion from electricity to air can be readily made in the field.

The air motor is bolted to a standard commercial Bendix drive assembly, and the combined unit fits into the space previously occupied by the electric starter. An extra air receiver—usually with a capacity of around 11 cubic feet—is needed and can often be put where the



TRUCK STARTING-SYSTEM ELEMENTS

The drawing shows the method of hooking up to the air compressor of the braking system without interfering with the operation of the latter.

heavy-duty batteries were formerly placed. Aeroquip hose serve as air lines, and a tee connection and check valves keep the starting and the braking air systems independent so as to guard against loss of braking air. The starter is actuated in the cab by means of a quick-opening valve.

The air motor itself is compact, sturdy and of simple design. Five vanes of phenolic material seat in slots in a hardened steel rotor that turns in a cylinder of hardened alloy. Compressed air enters and leaves through ports in the cylinder, meanwhile spinning the rotor. The motor is made in two sizes. The 9BM, which suffices for most starting applications, ranges from 7 hp when supplied with 75 psi air to 15 hp when the air pressure is 150 psi. It weighs 48 pounds. The 20BM ranges from 19 to 41 hp at the same pressures. It weighs 115 pounds.

The next logical step following the successful conversion of heavy vehicles to air starting in the field was to install similar systems in new vehicles when they were built, and that is being done. About a year ago, Mack Motor Truck Corporation began putting air starters in some of its new diesel-driven "cab-over-engine" tractor units, and several hundred of them are already in service. At least two other manufacturers are doing the same thing mainly because customers request such starters.

The first of the new Mack units went to Carolina Freight Carriers Corporation, of Charlotte, N. C., which has since then added 54 more to its fleet. The concern operates 170 semitrailers, 300 tractors and 50 trucks. The cab-over-engine model (see illustration) was designed to keep the combined length of tractor and trailer within the legal limit and still use a trailer body of maximum length and carrying capacity. From bumper to back, the cab measures not more than 80⅝ inches and the cab tilts forward at an angle of 45° to give access to the engine.

A 14x60-inch receiver back of the driver's seat stores air for starting service only and is connected to the starting motor by a flexible hose. After the braking system compressor has built up pressure in the brake-supply reservoir to 95 psi, a regulator opens the line to the starting-service tank, which has a check valve to prevent the flow from reversing. The compressor is set to unload when the pressure reaches 120 psi. Just beyond the check valve is a conventional Schrader tire valve to which a connection can be attached in an emergency so air can be obtained from a roadside service station. Provision is made for draining the tank of moisture by opening a hand valve, and a trailer hose-coupling connection known as the "glad hand" is affixed there to permit charging the reservoir on the road from another vehicle if that should become necessary.

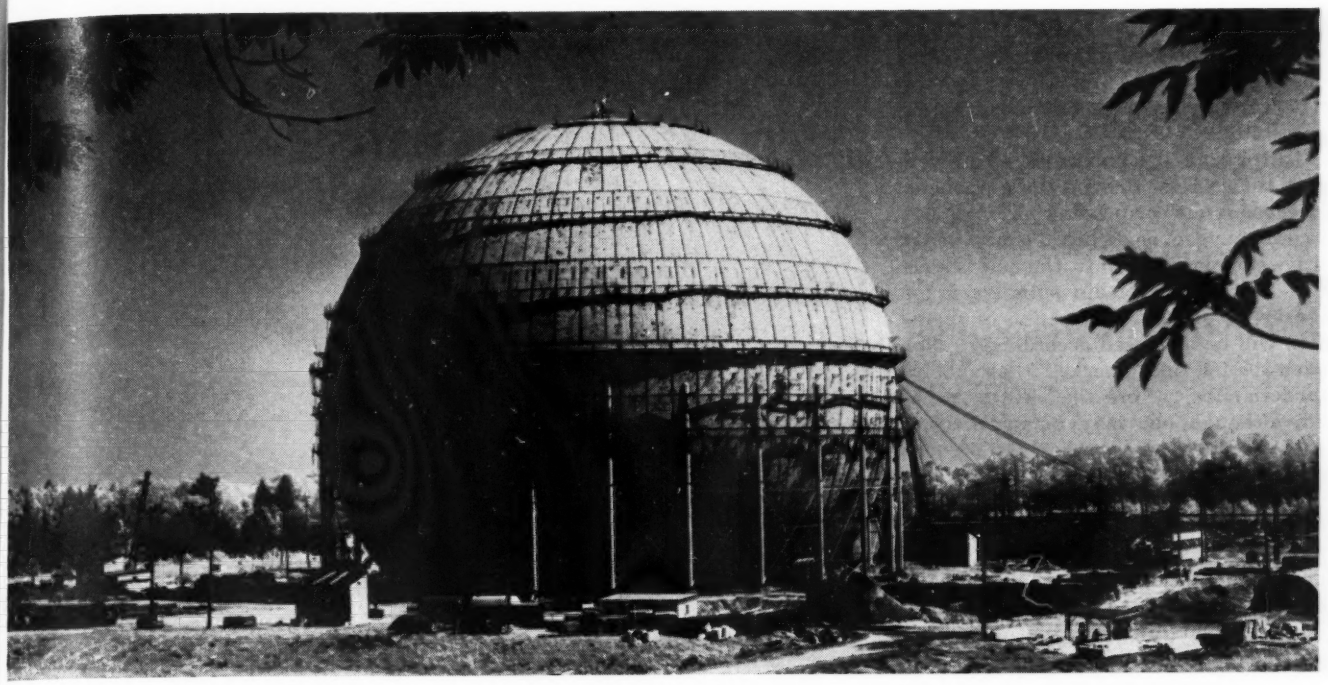
Johnson Motor Lines, Inc., also of Charlotte, N. C., which has some International cab-over-engine trucks with air starters, as well as a large fleet of electrically started vehicles, has made a comparison of weights between the two types. A complete electrical system weighs 481 pounds and an air system 208 pounds. The principal saving is effected by replacing a group of four heavy-duty batteries of 83 pounds each (332 pounds, total) with two 6-volt batteries that weigh 90 pounds. The latter are used in series to provide current for lights. Battery supports weighing 25 pounds are dispensed with. A reduction in the size of the generator saves 25 pounds, and the air-starter assembly itself is 12 pounds lighter than the electrical assembly. The only weight added by the air system is 40 pounds for an air receiver, but 9 pounds of that is offset by eliminating the switching equipment needed by the electrical system. The net saving, according to the comparative figures, is 273 pounds. As the trucking industry estimates that weight reduction can be converted into a cargo-carrying revenue of $2.50 per pound per year, the indicated annual saving of the air system on this score is $682.50.

When Passenger Cars Were Started by Air

IT IS interesting to recall that compressed air was at one time used to crank passenger automobiles. That was not done by spinning the engine, as is now the custom, but by introducing air under pressure to the various cylinders in the order of their firing, as is still generally the case with large stationary gas or diesel engines. The Pierce-Arrow of 1913, an aristocrat of that era's motor-car world, was equipped with a system that included a compressor or pump driven through gears by the car's engine, an air receiver located above the muffler, a distributor to feed the air to the cylinders, a pressure gauge on the dash and a control valve for bringing the compressor into play whenever it was needed. Air was stored at from 20 to 150 psi pressure. The distributor's essential element was a rotating disk having a slot through which air was admitted in turn to tubes connected with the several engine cylinders. Each cylinder received an injection on the downstroke of its piston.

In this same period the *Scientific American* reported that "the majority of leading car manufacturers have adopted automatic starters for their 1912 or 1913 models and specialty companies are in the market with self-starters of half a dozen different types." The air used was at 20 to 125 psi pressure, and a receiverful was ordinarily sufficient for 100 starts. The compressor of some of these systems was a single-cylinder affair that ran by impulses on its piston from the combustion chamber of one of the engine cylinders. Each pulse compressed a small volume of air, and the tank was filled in from 5 to 10 minutes running time. When the pressure in the tank reached around 150-175 psi, back pressure prevented more air from being compressed until some had been withdrawn.

The Enfield Autocar made in England had a compressor that was driven off the crankshaft. The air actuated a long cylinder piston which moved a toothed rack that drove a gear wheel and thus spun the engine.



ROUND HOUSE FOR A NUCLEAR ENGINE

With a diameter of 225 feet, this steel sphere dwarfs the next largest structures of that shape—five fuel storage tanks in Connecticut each 76½ feet across. The ball design was chosen for the operations discussed here because it provides the greatest possible unobstructed space. The Chicago Bridge & Iron Company, specialist in this sort of construction, spent ten months in erecting it. The two welds skirting its greatest girth are each 706 feet long. The men on top of the sphere are hard to see.

SUBS WILL BE FIRST

Atomic Power May Be Near

AT THE Knolls Atomic Power Laboratory, 18 miles from Schenectady, N.Y., workmen were recently completing the spherical structure pictured. Called the largest ball in the world, it was built by the Chicago Bridge & Iron Company to conduct tests by General Electric Company of a prototype atomic power plant for submarines. Having a diameter of 225 feet, the steel sphere rises higher than an 18-story building and encloses 5,964,000 cubic feet of space. Composed of 682 one-inch-thick steel plates and weighing 3850 tons, it is hermetically sealed by 5 miles of welded seams that were tested for leakage by means of X-rays during construction and with air pressure after the structure was put together. It was made airtight to prevent the escape of radioactive material even if all the numerous safety devices provided for that purpose should fail simultaneously. The shell will be about half filled with earth to provide a maximum of working space. The interior will be air conditioned, and people and materials will enter and leave through an air lock.

At Groton, Conn., the Electric Boat Division of General Dynamics Corporation is building two submarines, the *Nautilus* and the *Sea Wolf*, both of which are destined to be driven by nuclear power plants. One of them will most likely receive the reactor that is to be tested in the steel sphere, and the other may perhaps be propelled by a somewhat similar unit being developed by Westinghouse Electric Corporation. A replica of the central hull section of these underwater craft was fabricated adjacent to the sphere so that it could easily be moved inside for the experimental installation of the power plant.

These developments are the result of a decision by the U. S. Navy in 1948 to investigate the feasibility of nuclear-powered submarines. If they prove to be practicable, similar but larger power plants will be placed in bigger vessels. Meanwhile, the expense will have been kept down to a minimum, and if the subs work out as hoped they will give Uncle Sam a potent war weapon that may cause any unfriendly nation to proceed cautiously.

At Arco, Nev., in the Government's atomic-reactor testing station, another replica of a submarine section has been used since last March to test the Mark I, the first nuclear reactor devised by Westinghouse. This initial unit is not expected to reach sea water, but the Mark II, embodying improvements born of observations at Arco, is being prepared for tests near Pittsburgh, Pa. There, on a former airfield, buildings for that purpose have been erected by Westinghouse, but they are of conventional design as compared with the huge steel globe conceived by General Electric.

Both the G-E and Westinghouse reactors will produce heat, which will, in turn, provide steam for driving a submarine, but they will differ primarily in the speed of action. Both will derive their heat from the splitting of uranium 235 atoms, but splitting will be controlled to prevent the violent reaction obtained with an atomic bomb.

The Westinghouse creation will be of the type designated as the STR (submarine thermal reactor). The flight of the neutrons that bombard and split the uranium atoms will be held down to a comparatively slow speed by means of graphite "moderators." The heat generated by the reaction will be absorbed by water, which serves as a cooling medium. It will be held under pressure to prevent it from flashing into steam before it reaches the sub's boilers. The General Electric unit is called the SIR (submarine intermediate reactor) and its neutrons will be permitted to travel from ten to twenty times faster than those in the STR. Liquid sodium will be used to cool it and will transfer its absorbed heat to water, thereby producing propulsion steam.

There has not been a steam-driven submarine in this country since the pioneer builder J. P. Holland constructed

the *Plunger* in 1897. Lacking balance, the craft tended to roll over, had to be chained to a pier, and the Navy, for which it was designed, rejected it as unsuccessful.

In the nuclear submarines, steam will spin turbines for driving the propellers. Because a nuclear power plant does not require oxygen, as do diesel engines that drive conventional craft, the new vessels will be able to remain submerged for longer periods and their radius of operation will be increased accordingly. Not even the tell-tale "snorkel" that enables modern subs to "breathe" will be needed, although one may be included to provide fresh air occasionally for the crew, which will normally be supplied with respiratory air from high-pressure bottles. At the keel-laying of the *Nautilus* a little more than a year ago, President Truman said the vessel would have an underwater speed of 20 knots, which is approximately double that of today's submersibles. The nuclear fuel will weigh little compared with the 360 tons of fuel oil now required for a journey of 10,000 miles.

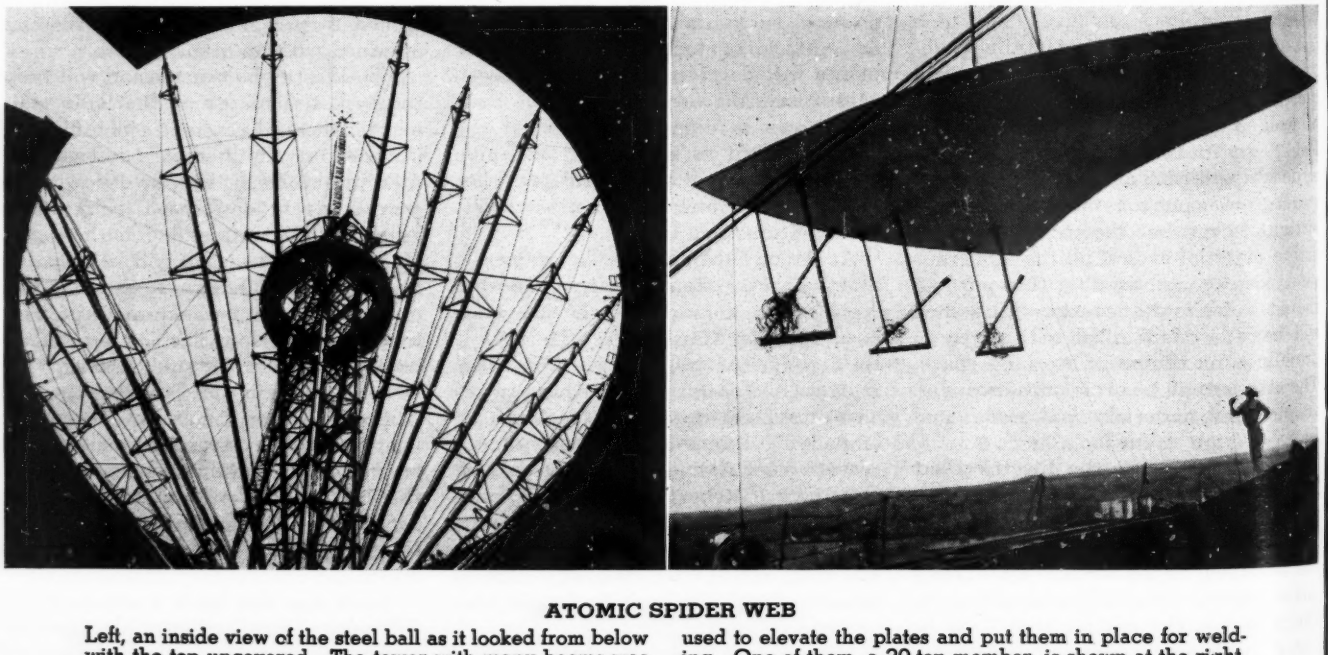
The building of the reactors involves many problems, including that of obtaining materials that will withstand the enormous heat created. Metals with which industry is familiar will not do this, but zirconium seems to answer the purpose. It is light and tough and, as it does not absorb neutrons, will not interfere with the functioning of the reactors. It is necessary, too, to prevent leaks that might liberate radioactive substances—chiefly the speeding neutrons and the gamma rays. In the submarines, screens of lead or some other suitable material will have to be erected to protect the crews against these invisible lethal agencies.

LOFTY WORKERS

Riggers, working high on a catwalk, secure one of the 682 curved plates that were welded into a continuous, leakproof skin. The exterior is insulated.

Operating costs won't matter too much in vessels used solely for military purposes, but they will be watched closely because of their bearing on the use of nuclear power for peaceful purposes in days to come. It is known that the experts are hopeful that the present cost of generating electric power aboard submarines, which is about eight cents per kilowatt-hour, can be equaled if not bettered. On large ships it comes to only around two cents, while the more efficient coal-burning central stations on land turn out approximately 5 kw for one cent.

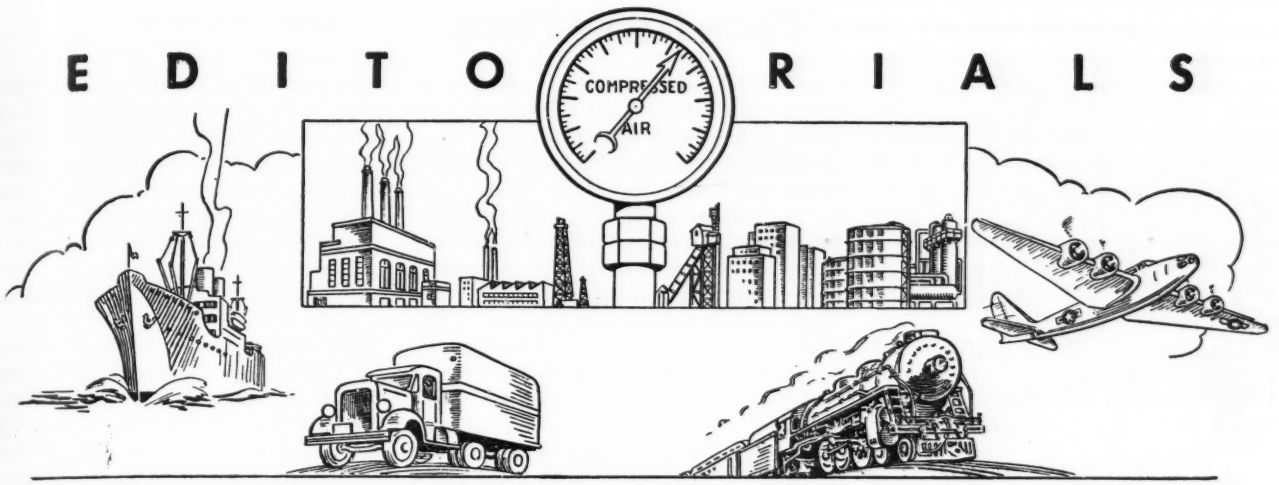
The last-mentioned mark is a difficult one to reach by the nuclear-power technicians, but they may succeed in time. From the work with submarines they will learn much, and meanwhile the Government has decided to make a start on what may be a long road leading to industrial and domestic atomic power at competitive costs. In October the Atomic Energy Commission authorized Westinghouse to begin the development of a nuclear-powered generating station that will produce at least 60,000 kw, which is sufficient to supply a city of 100,000 population. It is hoped to have it operating in three or four years. About the time this decision was announced word came from Great Britain that it is already building one full-scale atomic-energy plant and preparing to begin work on another.



ATOMIC SPIDER WEB

Left, an inside view of the steel ball as it looked from below with the top uncovered. The tower with many booms was used to elevate the plates and put them in place for welding. One of them, a 20-ton member, is shown at the right.

EDITORIALS



TOLL ROAD BENEFITS

EVERY now and then during the present century some invention or discovery has come along to stimulate employment and commerce and thus create or maintain prosperity. The automobile, airplane and television are examples. But pessimists periodically predict that there is nothing else conceivably ahead that can keep our steam up and that we are doomed sooner or later to lose the high standard of living to which we have grown accustomed.

There is reason to doubt that this will happen soon. The splitting of the atom, for instance, has opened up new horizons. No one can yet foresee what it will bring forth, but there are unquestionably great possibilities in such things as nuclear power and the industrial application of radioactive isotopes. Even in its present state of uncertainty the new science has put thousands of persons to work seeking for and mining uranium and given other thousands jobs in laboratories and plants that do something or other with fissionable materials.

Aside from the atom, what are the chances for another worth-while shot in the arm in the event our economy starts ailing? It may be that we are getting the first infusions of one right now and have failed to realize it. We have in mind the current revival of an old expedient—the toll road. The idea of providing motorists with de luxe facilities and letting them pay the bills as they ride seems to be going over strong, and if it keeps on snowballing it could put a lot of money in circulation.

In this issue is an account of the New York Thruway, already partly in service and scheduled for completion in little more than a year. This single superhighway, which will cross just one of the 48 states, is costing half a billion dollars. In the final analysis, essentially all that money is going into salaries and wages—to pay engineers and contractors' men and the machinists, stenographers and bosses in the legions of factories turning out materials and equipment that enter into such a project. And New York is but one of many states that are building, planning or thinking about toll roads. Some people believe a network of them will eventually criss-cross the nation.

If that should materialize, it may set new merchandising methods in motion, with more stores outside thickly settled areas where customers can park and shop more conveniently. It is bound, too, to increase the sale of automobiles, fuel and supplies and to help keep Americans on the go. It could be that the toll road is a Santa Claus that will put more jingle in a lot of pockets.

SKYSCRAPER RENAISSANCE

THE skyscraper is coming back! In New York and elsewhere around the country, tall structures are springing up like mushrooms, seemingly making up for the lean depression and war years. Since 1948, more than 100 large buildings have been thrust skyward in the nation—as many as were put up during the preceding fifteen years.

Two developments—strong steel of thin section and the elevator—made the skyscraper possible. The lower walls of lofty buildings were once many feet thick and their weight was tremendous. High-strength steel brought into being structures with trim metal skeletons that carried the load and required walls only thick enough to provide protection from the elements. High-speed elevators, in turn, obviated stair climbing and expedited vertical transportation.

Builders went on a spree with their new-found technique, and skyscraper became a romantic and witching word. Tall structures became especially popular in New York's Borough of Manhattan where space was at a premium and frequently too costly to make low ones economical. In the 1920's there was a race there to see who could construct the biggest, and the contest brought forth the fabulous Chrysler and Empire State buildings.

The 1929 crash all but squashed the skyscraper boom, stopping virtually everybody but the Rockefellers who carried over into the depression with the remarkable quarter-billion-dollar group of structures that constitute Radio City. Slowdown in business activity and employment during the 30's threatened to make the erstwhile advocates of skyscrapers look foolish. At the low point, vacancies in large New York office buildings as a whole reached 26 percent of the available space, and it is said that the Empire State Building was never fully occupied until war-nurtured organizations and the Government took over sixteen floors. There was talk that the skyscraper era was over; that the concentration of people unbearably clogged the transportation networks during rush hours and that elevators took up so much room that there was not enough left to rent to show a profit.

But time seems to have confuted all those arguments, for the skyscraper is back with a vengeance. There are differences, though, in today's thinking and practices. Builders are no longer trying to set records for height, and they aren't putting up structures first and then looking for tenants. A large proportion of the space is rented before ground is broken, and as most prospective occupants sign long leases, there is little risk of a flash depression creating stormy financial weather for the owners.

Back of this renaissance is the surprising sustained growth of Manhattan Island as a place in which to do business. There has been a reversal of the decentralization idea of a few years ago. In 1940 one million "white-collar" workers earned a livelihood there; today the New York State Department of Labor reports 1,500,000. Some of our large corporations have thought of moving their headquarters out of New York City to nearby Westchester County, for instance. A few still plan to leave, but others are putting up tall buildings or arranging to occupy those erected by others. Many of the new ones are being financed by big life insurance companies who usually investigate carefully before they invest. Evidently they have no misgivings about the future of the skyscraper.

This and That

Birth of Incentive Pay Idea

The incentive system, under which labor is paid extra for exceeding a given production quota, is not new. Actually, it has been used on this continent for more than 60 years and was introduced in a factory that made rock drills, air compressors and allied equipment. This is noted in a book, *I Remember*, by the late Dexter S. Kimball, for many years dean of the engineering school at Cornell University. He was long prominent in the American Society of Mechanical Engineers and recollected a paper, *The Premium Plan of Paying for Labor*, which was presented before the society in 1891 by F. A. Halsey, a pioneer designer of rock drills. Halsey put his plan for rewarding labor into effect while he was superintendent of the Sherbrooke, Que., factory of the Rand Drill Company (now Ingersoll-Rand Company). Dean Kimball added that Halsey, who edited the *American Machinist* for some time, was violently opposed to the introduction of the metric system of measurement into our industrial economy and gave his objections to it in a series of papers published in the transactions of the Society.

★ ★ ★

Search for New Materials

The coming atomic age has intensified the search for materials that will withstand high temperatures, and in order to do a better job in this direction three companies that have been working independently have teamed up. Under the name of Borolites Corporation, The Carborundum Company, Niagara Falls, N. Y., Firth Sterling, Inc., Pittsburgh, Pa., and American Electro Metal Corporation, Yonkers, N. Y., will pursue research on and the development of different metal compounds for military and civilian uses. It will deal with borides, carbides and aluminides that show promise of resisting operating temperatures from 1600 to 2000°F for turbojets and up to 7000°F for rocket nozzles and intermediate applications. Civilian uses of borides, which are combinations of boron with such metals as zirconium, chromium and molybdenum, appear to be in crucibles for melting metals, protector tubes for thermocouples, atomizing nozzles for metal-spraying equipment and electrical contacts.

★ ★ ★

Cranes Used in Quarries

Lifting stone out of quarry pits has been a difficult and expensive operation since the days of horse-powered whims. For a long time it has been done mostly by derricks and related equipment or by means of aerial tramways, some of which are awesome things to behold. Now a French marble-producing firm has improved upon the old practice by adopting gantry cranes such as are often used in this country for transporting and depositing concrete in big dams from steel trestles. At quarries near Boulogne, the cranes span the working areas and run on rails laid along the tops of the opposing walls. One at the Blecquenacque Quarry is 375 feet long, weighs 400 tons and can lift a load of 50 tons.

The first step in quarrying the marble is to cut vertical slots with wire saws to separate blocks about 115 feet long, 5 feet wide and 20 feet high. They weigh from 900 to 1000 tons apiece. After hydraulic jacks break each one loose from its bed, it is pulled over on its side, coming to rest on a mattress of broken stone that breaks the fall. It is next inspected for fissures, color and pattern variations and then reduced to smaller blocks weighing 50 tons or less. These are lifted by crane to the surface for further division and processing. This system results in much less waste than older methods. Rock that overlies the marble and waste that is created in the quarry are crushed on the property and sold as concrete aggregate and roadbuilding material, the annual output amounting to about 300,000 tons.

During the recent war, the invading Germans worked the quarries to obtain rock for constructing fortifications to defend the English Channel. They drilled and blasted the marble without regard for its quality, and when the French repossessed the properties, it took a long time to clean up and to reach stone that had not been shattered by the heavy shots. Some varieties that were turned out prior to the war have not yet come back into production. However, two pits, the Napoleon and Joinville, have been equipped with gantry cranes and a third opening is being similarly outfitted.

★ ★ ★

Deep are the Roots

The Seaman's Bank for Savings is constructing an office building on New York's Wall Street next door to the Subtreasury. The plot was previously occupied by the Federal Government's old Assay Building which had not been used for two decades. The bank negotiated for the property with Uncle Sam for five years and finally got possession of it by trading for it a structure in Brooklyn that was already partly tenanted by goverment departments.

Once upon a time the Assay Building handled a lot of gold that was made into shining coins—a practice that was discontinued in 1933. The Government wanted a safe repository for this valuable commodity and constructed the building for that purpose. The vaults were lodged five stories below street level where they were surrounded and safeguarded by unlimited quantities of Manhattan schist.

"Please! please! I've got 500 cups in the oven!"

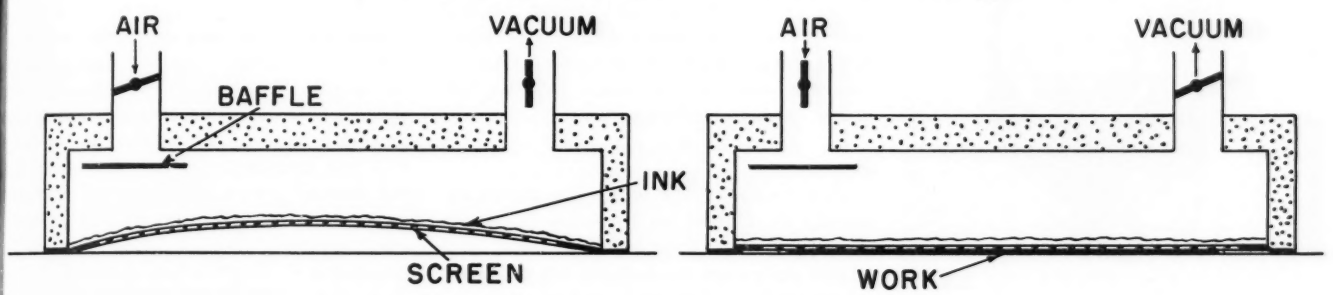
Even though it deals in money and will no doubt have considerable amounts of it around at times, the bank expects to get along with a 3-story basement and may fill in the two lowest subterranean chambers despite the fact that it cost a small fortune to hollow them out.

Another interesting detail about the old building is that its floors were constructed to carry 1000 pounds per square foot, a truly phenomenal load for that class of structure. (Those in the new building will be designed to support 120 pounds.) That made it difficult to demolish the veritable fortress.

Gold Loses Glamour

How government policies or regulations can change the economy of a state is shown in recent statistics on the mineral output of Colorado. Gold, which was responsible for the settling and development of Colorado, is no longer among its principal products. The $35 per ounce it now brings, a price that has remained unchanged since 1933, enables only a very few of the richest or best-run mines to continue in operation. As a result, many properties that were once symbols of opulence have lost their luster and glamour. In fact, gold, which used to head the list of minerals year after year, is now down in the ruck. Oil and uranium, both virtually unknown when gold seekers rushed into the high Colorado Rockies in 1859, now stand one-two in the tabulation, oil at $76 million in 1952 and uranium at an estimated $50 million. Lagging far behind in third position was molybdenum at $27 million; zinc was in fourth place at $17 million; and gold a poor fifth with a puny $4 million. Even the nonmetallics such as gypsum, limestone, mica and granite brought in three times as much as the onetime leader.

Pneumatics in Silk-Screen Printing



APPLICATION for patent protection has recently been filed by Paul Sprinzel, an artist of London, England, for a silk-screen printing process that makes use of both vacuum and pressure and is said to reproduce very fine lines as well as deposit heavy layers of ink. If found to be practicable, it will be an important advance in the art, which was practiced hundreds of years ago by the Chinese.

In those days the stencils were made by cutting intricate designs in duplicate in rice paper and pasting the two together by interposing strands of human hair or silk to which glue had been applied. Laid on cloth to which the motifs were to be transferred, color was then put on by brushes made of hog bristles and cut to a fine point. Today, this is done by squeegees, and long-lasting stencils are affixed to the undersides of silk screens, from which the method gets its name. The silk is stretched taut in a frame, and all but the designs is blocked out in one way or another.

Quantity production of silk-screen work did not begin until 1914 and was used mainly for making signs. It is still largely a hand operation, but now has a wide range of application. With Sprinzel's machine there is every indication of an upswing in the business, which is reported to be "the least mechanized in the graphic arts." As the accompanying drawings show, the equipment consists essentially of a box or head which contains the printing ink and has two apertures at the top, one for an air and the other for a vacuum connection. The screen is fastened above the work, which is laid on the bottom, and is held away from the latter by drawing a few inches of vacuum, or just enough to give it a concave form. The head is then lowered and aligned without the transfer of ink. When ready for printing, the vacuum is broken and compressed air is applied, forcing the ink through the screen.

Contact between the screen and the work and the air pressure used vary with the operating speed, the consistency of the ink and other factors. During a demonstration of the process, 40 psi was applied for about eight seconds and the designs transferred were well defined. By substituting compressed air for the squeegee, the color is applied under uniform pressure throughout, and it is also possible in one pass to handle wide materials such as textiles that would require the use of two or more of the conventional applicators.

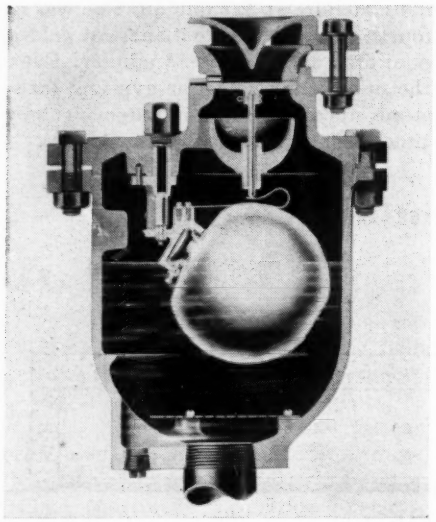
Circle 1E on reply card

MOVING A COMPRESSOR IN 1912

Today's transportation facilities make it comparatively easy to move machinery into isolated places. Before they were available, a resourceful purchaser of an air compressor resorted to the method pictured to move its frame inland from a Brazilian port. The machine was stripped down and the flywheel made to serve as the third wheel of a cart. The wheel was wide enough to keep from sinking far into the mud, and the improvised conveyance was short enough to take the sharp turns readily. With sixteen oxen pulling, the load could be moved about 5 miles a day during the rainy season on roads with a maximum grade of 12 percent. When going downhill, a wedge was driven between the face of the wheel and the bedplate to serve as a brake.

Industrial Notes

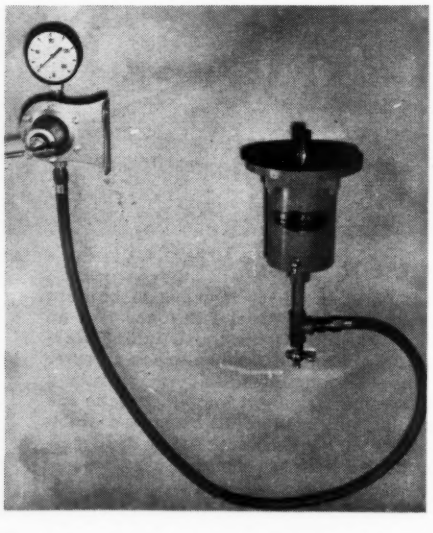
For the purpose of automatically releasing accumulations of air from piping, admitting air to systems in order to break vacuums, and venting large quantities of air from pipe lines when filling



them with water, Simplex Valve & Meter Company has designed a valve that is said to perform these three functions—permit the intake and exhaust of air through one body. Compact in design, it has a 2-inch threaded inlet opening, a maximum diameter of 11½ inches and an over-all height of 16¼ inches. The Type AV, as it is designated, may be used under working pressures up to 150 psi wherever difficulty is experienced with air accumulations in pipe lines or flow of water because of air binding. The illustration shows the valve in the closed position.

Circle 2E on reply card

A new self-contained pneumatic die cushion offered by Dayton Rogers Manufacturing Company is of all steel construction and provided with a hardened and ground pin pressure pad made to



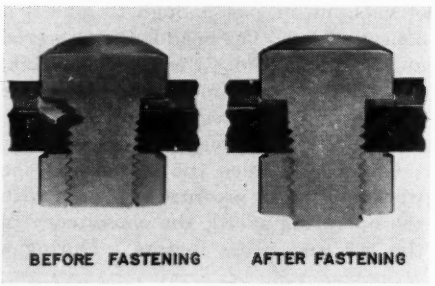
specific die- and punch-press requirements. Available in 2- to 7-inch piston diameters, the Model CR, as it is designated, may be fastened directly to the bolster plate by one drilled and tapped hole or passed through the bolster plate and fastened to the die shoe. It is provided with a reducing-regulating valve and pressure gauge which gives a continual record of the working pressure on the die-cushion cylinder.

Circle 3E on reply card

In addition to black, Reynolds Industries, Inc., is now offering white, red, blue, green, orange and yellow stencil ink in handy aerosol dispensers. Colors are waterproof and are suitable for marking cartons, crates, steel drums and other metal products.

Circle 4E on reply card

Stat-O-Seal is the name of a device recently developed by Franklin C. Wolfe Company, Inc., for sealing bolts and studs subjected to liquids, air or other gases under either high or low pressure.



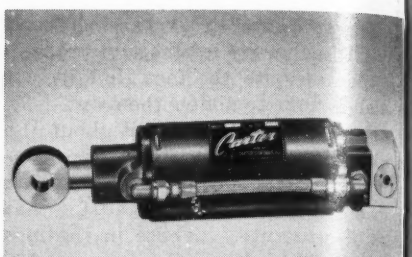
Of one-piece construction, it is non-directional and cannot be assembled upside down. An "O" Ring gland is mechanically fastened to the metal retainer, thus obviating the need of sealing compounds. It is claimed that high fastening torque is not required to effect a seal because there is always full metal-to-metal contact without load transference to the gland.

Circle 5E on reply card

Wire rope from ⅛ to 1½ inches in diameter can now be obtained accurately marked with bands of gold at 5-foot intervals so that users can cut off any required length without the need of measuring devices. The idea was conceived by Paulson-Webber Cordage Corporation, which will also supply rope calibrated to customers' specifications.

Circle 6E on reply card

Carter Controls, Inc., has announced a new line of air cylinders featuring a built-in operating valve. These "power packages" eliminate one pipe connection usually required for a double-acting cylinder and are said to increase effi-



ciency by reducing line friction. The valve is of the universal type so that it can be actuated by direct- or remote-controlled miniature poppets or converted to single- or double-solenoid operation. It can be furnished with dual speed controls. The cylinders range in diameter from 1½ through 6 inches and, like the standard type, save space. A full line of 2-way poppets for air-limit, hand or foot operation are available in addition to standard electrical conversion units.

Circle 7E on reply card

A disposable paper work cap developed by Du Pont safety engineers for use in one of the company's large chemical plants is now available to other industries through the Record Industrial Company. The headgear, made of heavy crepe-textured Kraft paper, is water-repellent and flame-retardant. A small percentage of neoprene latex added to the pulp during the papermaking process gives the finished product unusually high wet strength and increases its resistance to the action of acids and alkalies. Made in the conventional style and

WORKERS LIKE THEM

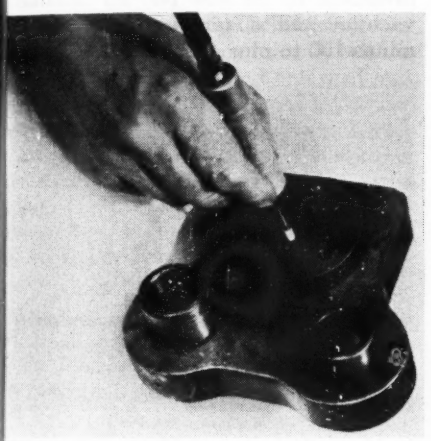
The trim cap on the man's head is made of paper and is said to last about as long as those he is holding, which are of cloth. The lower one is new and the other has been washed. It's so shabby when it comes from the laundry that it is often discarded before it is worn out.

sewn together in the same manner as a cloth cap, it has a visor with cloth binding and a leatherette sweatband. It holds its shape well, does not collect dust, sells for about a third less than the familiar cap and is available in all sizes.

Circle 8E on reply card

A new air-powered grinder that is claimed to be the smallest and lightest on the market is being manufactured by Nu-Jett Products, which says that it develops up to 110,000 rpm. Because of its high speed, abrasive wheels are said to last three times as long as when used on slower tools. The Nu-Jett is designed for service in such diversified fields as die making, wood carving, fine etching, polishing and finishing. Because of its speed, it can be utilized to put a mirror-like finish on metals.

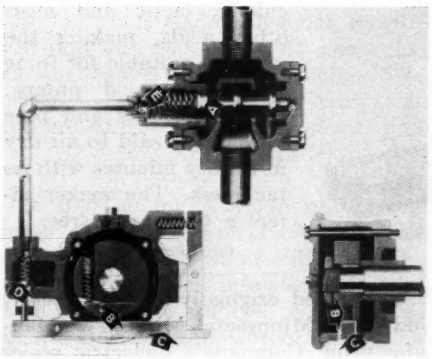
The design is simple and based on the principle of opposed spirals, which run



the full length of the barrel and rotor. The only moving parts are the rotor and two ball bearings, and the latter are standard and can be replaced if necessary. The tool will operate on air pressures of 50 psi or higher. Exhaust air comes out the front end and blows dust away from the working area.

Circle 9E on reply card

For its line of steam turbines, Coppus Engineering Corporation has developed an excess-speed stop valve that is designed to function independent of the constant-speed governor and to eliminate the usual levers between the safety trip mechanism and the shut-off valve. The valve stem does not protrude beyond the valve body, a feature that prevents sticking through boiler compounds or other foreign matter in the steam as well as accidental damage. When the turbine is operating, lever "C" is horizontal, pilot valve "D" is closed and valve "A" is held open by spring "E." When excess speed is reached, centrifugal force throws weight "B" against lever "C," opening pilot valve "D." This relieves pressure back of valve "A," unbalancing and closing it immediately, compressing spring "E" and shutting off the steam



supply to the turbine. When lever "C" is manually reset, pilot valve "D" closes, allowing pressure to build up back of valve "A" and thus restoring the balance. Spring "E" then opens valve "A," admitting steam to the turbine. The new stop valve can be incorporated in old-style valve bodies.

Circle 10E on reply card

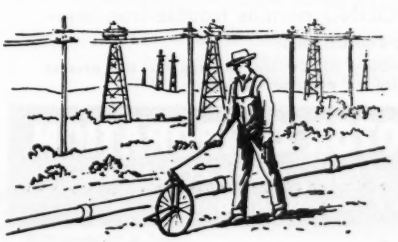
Straight edges for measuring and checking machine-tool beds and other surfaces that must be absolutely flat are a new product of Collins Microflat Company. Made of black granite with leather ends for easy gripping, they are temperature inert and stable and do not require oiling. They are said to be accurate within 0.00005 inch and are available in different lengths (maximum, 48 inches).

Circle 11E on reply card

After eight years of research, Dow Corning Corporation has produced a silicone enamel for magnet wire that is said to be comparable in physical properties to the better organic enamels. Applied to wires in test motors, the coating was found to be in excellent condition after 1500 hours of operation at 437°F. The enamel will soon be available commercially.

Circle 12E on reply card

The Rolatape shown below is essentially a tape measure on a wheel. The operator simply pushes it ahead of him as he walks, or he holds it while riding in a slow-moving car. The handle collapses for easy storage. Small pins protruding from the side of the wheel at 1-foot intervals actuate a mechanical counter that tabulates the number of feet traveled. Smaller increments than one foot are obtained by measuring the distance from the counter to the last pin in contact with it.



Rolatape is available with wheels that are 2, 4 and 6 feet in circumference. The small one is for hard-surfaced areas and registers up to 100 feet on the counter; the 4-foot size is for use on dirt roads; and the 6-foot wheel is for rougher cross-country terrain. The two larger ones register up to 100,000 feet (almost 19 miles). All can be reset to the zero mark at will and weigh less than 10 pounds each.

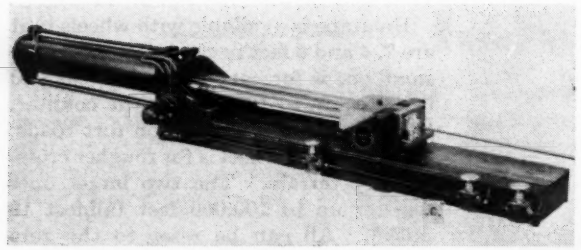
Circle 13E on reply card

For broaching holes, keyways and contours on a wide variety of production parts, the National Broach & Machine Company has designed a horizontal, self-contained broaching fixture that is powered by compressed air and is said to cut equipment costs. The machine consists of a cast-iron base with a 25-inch-stroke air-hydraulic cylinder mounted on a flange at one end and of a work-rest plate supported by a flange in the middle. Two hardened and ground steel bars guide an automatic broach puller attached to the piston rod. Movement of the pneumatic cylinder is controlled by a 4-way valve through the action of three manually operated pilot valves. In service, the broach is inserted through the work piece into the puller. Then Nos. 1 and 2 pilot valves are depressed simultaneously and cause the cylinder to draw the broach through the part.

NEW LAPPING MACHINE

Each of the men shown are lapping two small pieces on a new machine manufactured by Spitfire Tools Company. The revolving cast-iron plate is 24 inches in diameter and 2 inches thick and has an Archimedean spiral grooved into the top covered with abrasive. The work is held against it lightly. The machine is reported to be suitable for finishing all manner of parts that are required to have exceptionally flat and smooth surfaces. The plate is mounted on ball bearings and is turned at 1800 rpm by a ½-hp motor.

Circle 14E on reply card



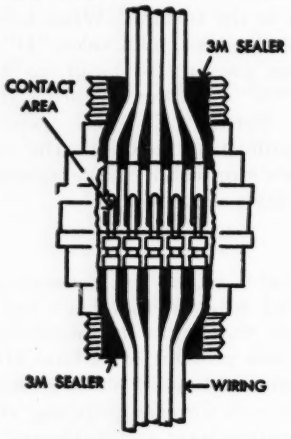
After the latter is removed the cylinder is actuated by pilot valves Nos. 1 and 3, thus returning the broach and releasing it before the operation is repeated. Cycle time to rough and finish the close tolerance valve-spool-hole broach in the tractor part shown in the accompanying illustration is fifteen seconds. Rate of broach travel is adjustable, and the fixture has a 1400-pound pull with a line pressure of 80 psi.

Circle 15E on reply card

"Clean the surface and just brush or spray it on," are the directions given by Babbitt Steam Specialty Company for the application of its recently introduced Formula 67, a coating for metals, wood, glass, brick, unglazed tile, cement, concrete and other masonry. According to the manufacturer, a single coat without primer covers, seals and protects against corrosion and acid fumes as well as immersion in nitric, sulphuric, hydrochloric, lactic and most other acids, making the material suitable for fume ventilators, acid pumps, tank cars, vats and pipe lines. It is said to air dry in twenty minutes with no tackiness. The maker offers a test quart free.

Circle 16E on reply card

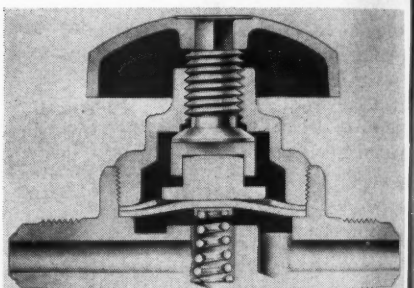
Developed originally for the aircraft industry, Minnesota Mining & Manufacturing Company's dielectric sealer



is now available for use by the electrical industry. A synthetic compound applied in liquid form, it is cured through chemical action into a tough, flexible rubber that is said to provide long-lasting protection against corrosion and vibration. The sealant also resists moisture and, according to the maker, retains its physical properties throughout a temperature range of –65 to + 200°F.

Circle 17E on reply card

Red-Head is the trade name of a new packless shut-off valve that is especially adapted for vacuum and pressure applications, instrumentation, processing and similar industrial uses. A product of The Imperial Brass Manufacturing Company, it is reported that the device, because of its soft seat, provides positive shut-off with fingertip control and stands up under unlimited openings and closings. The valve has a solid teflon diaphragm that resists all liquids and gases except fluorine, chlorine trifluoride and molten alkali metals and is designed for pressures up to 300 psi, an ultrahigh vacuum and a temperature range of minus 100 to plus 450°F. It is available



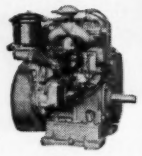
in ¼- to ⅞-inch, outside diameter, with a 45° flare or solder connection for tube installation and in ⅜- and ½-inch female pipe-thread sizes.

Circle 18E on reply card

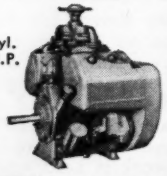
As a result of internal improvements, Van Products Company's Vi-Speed dehumidifier and filter is said to be better adapted for processing compressed air

WISCONSIN *Air-Cooled* ENGINES

Single cyl. 3 to 9 H.P.



2-cylinder 7 to 15 H.P.



V-type 4-cyl. 15 to 36 H.P.

Fit the Job and the Machine

Because Wisconsin Air-Cooled Engines are supplied in a complete power range, from 3 to 36 H.P., in 4-cycle single cylinder, 2- and 4-cylinder types, there is an ideal size to fit all types of machines and power applications within this range, without wasted power and with maximum power service benefits. Heavy-duty construction, combined with extremely compact design and light weight are added advantages—and dependable AIR-COOLING permits trouble-free service under all climatic conditions.

Specify Wisconsin Heavy-Duty Air-Cooled Engines for the utmost in power satisfaction. Write for descriptive data.

WISCONSIN MOTOR CORPORATION

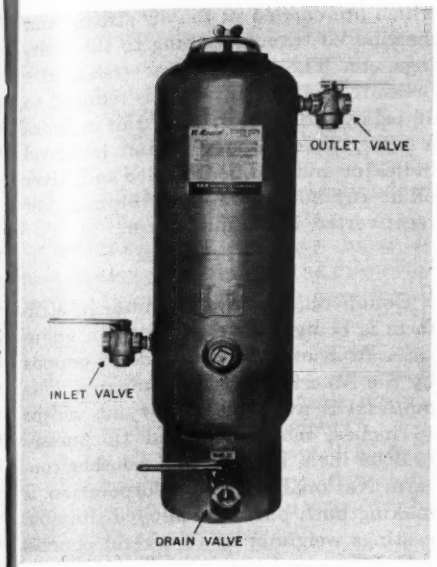
World's Largest Builders of Heavy-Duty Air-Cooled Engines

MILWAUKEE 46, WISCONSIN

A 7111-⅛-R-4

Circle 16A on reply card

"That's the biggest dang inch I ever saw."



under conditions differing widely as to humidity, temperature and atmospheric pollution. The principal changes in design are a self-adjusting nozzle with a nonclogging aspirator and enlarged and repositioned baffle surfaces. The former serves to stabilize unit operation under varying air pressures as well as volume for the continual removal of vaporous contaminants, liquids and solids. The baffle offers impurities greater exposure to the action of Dryolite, a self-cleaning drying agent; has a larger area for the removal of heavy particles; and is designed to take care of momentary overloads. The unit can be used with safety in flammable atmospheres.

Circle 19E on reply card

Structoglas is a new sheet material of glass-fiber reinforced plastic for skylights and window walls. It is said to filter out the infrared and ultraviolet rays of the sun and is available in different colors and grades with low or medium light-transmitting properties. A product of International Molded Plastics, Inc., it is made either flat or with standard corrugations to fit steel, aluminum or asbestos siding or roofing. The material can be worked with hand tools and bolted directly to a structure.

Circle 20E on reply card

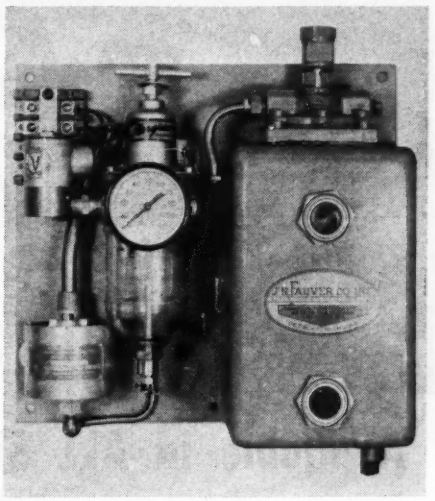
It is becoming common practice to spray a coat of waterproof plastic on grilles, seats and tires of military tanks and other vehicles intended for shipment overseas or storage. A product of R. M. Hollingshead Corporation, it is easily stripped off, but is left on seats and tires as a permanent protection when the conveyances are put in use. The plastic comes in colors to match the vehicles.

Circle 21E on reply card

For measuring vibration acceleration up to 50 gs in large rotating apparatus such as steam and gas turbines, turbine generators, motors, blowers and centrifuges, General Electric Company has developed a highly sensitive crystal-type accelerometer. Called the Vibration Detector, its output voltage is proportional to the acceleration imparted to the equipment on which it is mounted, but only in the direction perpendicular to the mounting plane. The device weighs only 4 ounces, and the critical barium-titanate crystal stack and components are shielded by a cup-shaped end mass that helps to guard against change of sensitivity in most corrosive atmospheres.

Circle 22E on reply card

Oil-Air is the name of a fully automatic lubricating system recently announced by J. N. Fauver Company, Inc., for plain, ball and roller bearings,



vees, slides, ways, rollers, cams, chains, gears and transmissions. With no moving parts, it operates entirely on compressed air and is said to apply a constant and uniform oil film. The lubricant is atomized into microscopic particles,

"I almost didn't make it this morning."

Simplify Your Coal Storage with a

ONE MAN SAUERMAN MACHINE

Here's how a Sauerman machine solves two of your biggest coal storage problems . . .

√ **PROTECTS AGAINST SPONTANEOUS COMBUSTION** . . . "Layers-in" the coal to prevent voids which form dangerous air-pockets or flues.

√ **PROMOTES BETTER LABOR RELATIONS** . . . Operator is in safe, comfortable position overlooking the work area. A satisfied employee eliminates "FLOATING LABOR".

Speed and economy of operation, ease of maintenance and low power consumption compared to tonnage handled are other important advantages provided by Sauerman Stockpiling and Storage equipment.

Learn all the facts from Sauerman's Catalog D . . . illustrates and describes actual applications in Sauerman's many years of serving the industry.

Write today for your copy.

548 S. Clinton St. Chicago 7, Ill.

SAUERMAN BROS., Inc.

Circle 17A on reply card

GARLOCK Service-Tested LEATHER PACKINGS

Available in ALL SHAPES, ALL SIZES, ALL TANNAGES and ALL TREATMENTS

GARLOCK's modern, completely equipped leather packing manufacturing plant has the facilities to furnish *all types* of leather packings. This plant maintains the same high standards of materials, design, workmanship, and inspection that Garlock has upheld for the past 66 years in the manufacture of mechanical packings.

SHAPES

Molded Cups "U" Packings "V" Packings Washers Gaskets Discs Flange or Hat Packings

SIZES

All sizes suitable for leather packing applications from ⅛" O.D. (such as leather washers for needle valves) to 99" O.D. (such as large "U" packings for heavy duty hydraulic service).

TANNAGES

Oak Chrome BITAN*

Garlock Bitan combines the heat and oil-resisting qualities of chrome with the fine grain, non-porous, strong qualities of oak.

TREATMENTS

Oil, grease, or wax treated (and combinations of these impregnants)—in degrees of hardness from extremely soft and flexible to very hard and rigid.

Synthetic rubber impregnated—combines the high tensile strength of leather and elasticity of rubber, and gives greater temperature resistance.

With fabric liners.

Untreated—for certain low pressure water applications.

Put your leather packing problems up to Garlock. Contact your Garlock representative or write for leather packing folder today.

*Registered Trademark

THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK

Sales Offices and Warehouses: Baltimore • Birmingham • Boston • Buffalo • Chicago Cincinnati • Cleveland • Denver • Detroit • Houston • Los Angeles • New Orleans • New York City • Palmyra (N.Y.) • Philadelphia • Pittsburgh • Portland (Ore.) • Salt Lake City San Francisco • St. Louis • Seattle • Spokane • Tulsa.

In Canada: The Garlock Packing Company of Canada Ltd., Toronto, Ont.

GARLOCK

PACKINGS, GASKETS, OIL SEALS
MECHANICAL SEALS
RUBBER EXPANSION JOINTS

Circle 18A on reply card

which are carried in the air stream and distributed through tubing to the bearings, etc. The air enters the system at a pressure of 100 psi, which is reduced to 10 psi by a regulator. The unit includes a filter, water separator and low-level indicator and can be installed to deliver oil at any point completely atomized or reconverted into liquid form.

Circle 23E on reply card

Commercially pure titanium in strip form is being offered industry in quantities from one to thousands of pounds by the American Silver Company. The material is available in varying widths (8 inches, maximum) and thicknesses (0.0005 inch, minimum). Another concern, National Research Corporation, is making both pure and alloyed-titanium castings weighing up to several pounds.

Circle 24E on reply card

Mobility is one of the features of a new heavy-duty jack lately announced by Joyce-Cridland Company. Provided with two wheels with semipneumatic tires and with a massive base the unit is operated by a 5-hp rotary air motor and has a capacity of 100 tons. Another feature is an accessory toe-lift adaptor which permits picking up a 75-ton load from a level 9 inches above the floor and raising it 13¾ inches.

Circle 25E on reply card

QUOTES

—FROM HERE AND THERE

Research in Air Pollution Aided with Aerosol Camera

"Long-sought clues to the nature of microscopic particles floating in the air are expected to be discovered by photographing them with a new Aerosol camera developed by Sanford Research Institute.

"The camera, which should prove valuable in smog and fog studies, can photograph airborne solid or liquid particles as small as 0.002 in. in diameter. In earlier air research, particles had to be collected on slides and examined with an electron microscope. The new camera should indicate whether or not the process of settling the aerosols on a slide alters or destroys some of them."

Engineering News-Record, October 8, 1953

Even TV Uses Compressed Air

"On the screen it looked like fire and brimstone when the 16 June Taylor Girls put on a devil dance for the Jackie Gleason show. But behind the scenes it was mainly dry ice and lycopodium powder, which flares like the old time photo flash, that caused the effect.

"There also were 'flashpots' to set off

the powder, devices to generate air pressure, fog machines and baskets to hold the ice and a supply of hot water.

"The scene was set by placing pounds of dry ice in baskets where the devil was to enter. Then the baskets were dunked into the hot water to create the smoke and fog effect. The fog machines added supplementary ground smoke.

"Additional dry ice was hung in baskets along pipe lines in the flies overhead and streams of smoke were forced down under air pressure.

"The fire, kept carefully under control, spurted up every time a stagehand pressed an air button to force lycopodium powder past the 'flashpots.'

"Although the stage seemed to be a swirl of smoke and at times, flame, the chemicals were not harmful either to the performers or the scenery."

Easton Express, December 5

Compressed Air Better Than Brush

At comparatively small cost, according to engineers of Pitman-Moore Company, small cans containing powdered pharmaceutical products are improved in appearance by use of a blowing device that removes dust from under the rolled edges of the lids that an operator could not get at with a brush.

The "unit consists of two sections of ⅜" OD copper pipe bent over at an angle and flattened at the end. They are located on either side of the can conveyor line—just after the lidding operation. These two pipes are hooked up to existing plant air facilities. A solenoid valve on the air line is actuated by a tripper device on the can line.

"Each passing can engages the tripper and thereby receives a blast of air from the pipes at about 15 to 20 psi. The pipes can be adjusted vertically and horizontally to accommodate cans ranging in diameter from 1¼ to 7" and in height from 2 to 9". Overhead is a suction hood which draws off the dust-laden air."

Chemical Processing, November, 1953

Immunizing Lubricants Against Oxidation

"Oil engineers have come to look on hydroperoxides or organic acids as chemical villains responsible for the deterioration of lubricants, and they are constantly seeking for ways to defeat them.

"Now the National Research Council of Canada has developed a process for making lubricating oils last several times longer by introducing into the oils agents that will counteract oxidization.

"Lubricating oils exposed to heat and air are slowly attacked by oxygen, forming hydroperoxides. From there on the deterioration of the oil is very rapid, apparently because of a chain reaction.

BEST ALL-AROUND PLAIN END PIPE COUPLING ON THE MARKET!

HERE'S WHY... *The Roust-A-Bout grips (teeth) take a strong, positive, circumferential bite on the pipe—as does a Tubing or Pipe Slip. The curved grips assure maximum gripping area for greatest holding power. This is the exclusive Roust-A-Bout, bull dog grip.*

Why accept less than the best when you are using plain end pipe couplings? Victaulic Roust-A-Bouts are specially engineered to provide the most reliable pipe connections you can use. With inclined, curved grips they bite into pipe circumference—provide a far stronger and surer hold.

Roust-A-Bout Couplings are just what the name implies—reliable, sturdy, adaptable and ingenious—ready for those tough field jobs where only plain end pipe is used or where the simple Victaulic Groove Method is not quickly available.

Victaulic Roust-A-Bouts are quick and easy to install:...

- You *cut* and *couple* your pipe as you go!
- You can use *plain* or *beveled end* pipe!
- You can use *new* or *used* pipe!
- For use on *permanent* piping or *repair* work!
- You need only one tool—a *socket wrench!*
- Roust-A-Bouts are simple and factory finished!

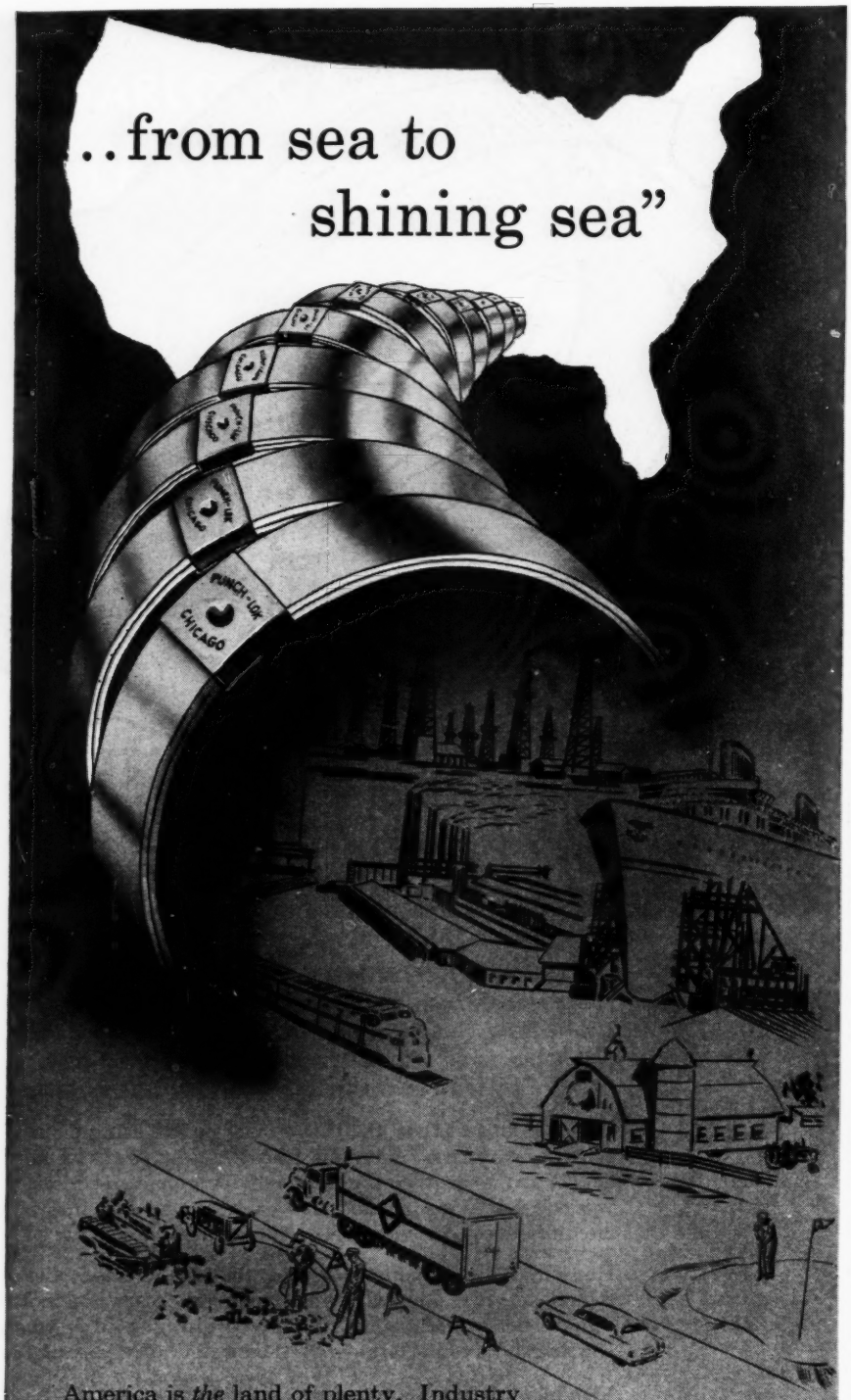
For your next job—insist on the best—Victaulic Roust-A-Bouts. They're available at all Victaulic Stocking Supply Houses in pipe sizes—2", 2½", 3", 3½", 4", 5", 6", and 8".

Write today for the Victaulic Roust-A-Bout Catalog No. 44-8B

VICTAULIC COMPANY OF AMERICA • P. O. BOX 509 • **ELIZABETH, N. J.**

Office and Plant: 1100 Morris Ave., Union, N.J. • Telephone Elizabeth 4-2141
West Coast: Victaulic Inc., 2330 East 8th St., Los Angeles 21
Canada: Victaulic Co. of Canada Ltd., 406 Hopewell Ave., Toronto 10
Export: Pipe Couplings, Inc., 30 Rockefeller Plaza, N. Y. 20, N. Y.

Circle 19A on reply card


..from sea to
shining sea"
PUNCH-LOK
CHICAGO
America is *the* land of plenty. Industry
has made it so. In America's great industries—
wherever leakproof hose connections are required
—Punch-Lok hose clamps can be found making their con-
tribution to America's growth. Only Punch-Lok does
so many jobs . . . so well!
"The Sign
of a Good
Hose Clamp"
See your near-by Punch-Lok Distributor
Punch-Lok COMPANY
321 North Justine Street • Chicago 7, Illinois

Circle 20A on reply card

The secret of avoiding this would seem to be to attack these hydroperoxides as soon as they are formed, and it has been found that they can be rendered harmless by reaction with added chemicals.

"Materials that can slow down oxidization include metals defined as 'highly positive,' such as lithium, sodium, potassium, magnesium, or their salts and oxides.

"Possible ways in which these counteracting agents may be added to oils include attaching a piece of metal to the drain plug, dispersing the material in the oil itself, and impregnating the filter."

World Digest, October, 1953

Safety Object of Shallow Trench for Air and Electric Lines

"Fairchild Aircraft Div. has developed and installed a new type of service channel system in a hangar floor. Service channels for both high and low potential electric service lines and air hoses are formed of hat-type sections of 10 gauge steel bedded in the concrete flooring. They are one in. wide at floor level, but are three in. wide at the bottom, with a depth of 2½ in.

"A major advantage of the system is that it overcomes the problem of gases collecting in deep floor trenches, with attendant explosion and fire hazards. Regular disconnects may be used with the Fairchild system, instead of the vapor-proof disconnects required for conventional trench wiring."

Automotive Industries, October, 1953

Ancients Knew Power of Air

In an article on *The Uncanny World of Automata*, Anthony Benis says: "Archytas of Tarentum (400 B.C.), a famous mechanician and mathematician . . . constructed a flying dove. Made of wood and balanced by counterweights, the dove moved by the force of air compressed within it . . . .

"The great period of large automata came in the eighteenth century. Figures moved by various devices sing, write and play musical instruments. There are mechanical magicians and speaking heads, the latter the forerunners of the modern phonograph. The masters of this art were the Swiss clock-maker Pierre Jacquet Droz, his son Henry, his apprentice and associate Jean Fréderic Leschot, and their partner Henry Maillardet . . . .

"They created the mechanical singing and whistling bird, in which the sound is produced by tiny bellows, moved by a system of levers and cams, compressing the air and driving it through a series of minuscule pipes. By clever arrangements of this complicated mechanism, whole tunes of bird songs and whistled arias could be faithfully reproduced. A spring-wound clock movement supplied the power." *Time, November, 1953*

Books and Industrial Literature

Industries for Small Communities, by Arthur E. Morgan, is the life story of an actual community's success in developing a varied group of thriving industries which today offer its young people economic opportunities rarely equalled in small towns. The book was written to demonstrate by case study that small industries in small communities play a major role in the new technology and that they may be the means of providing excellent conditions of life and work in the society of tomorrow. The author, former president of Antioch College and first chairman of the Tennessee Valley Authority, is now president of Community Service, Inc., an organization devoted to the study and encouragement of wholesome, creative life in rural communities. Publisher, Community Service, Inc., Box 243, Yellow Springs, Ohio. Price, $2; paperbound edition, $1.50.

Metals Engineering—Design, edited by Oscar J. Horger, Chief Engineer, Railway Division, The Timken Roller Bearing Company, is the fourth volume to be added to the ASME Handbook. A work of 405 pages sponsored by the Metals Engineering Handbook Board of ASME, it brings together in convenient form much important reference data on the design function in metals engineering. Forty-eight separate sections, contributed by authorities writing on the subjects in which they gained recognition, discuss such topics of design as fatigue characteristics, wear consideration, impact, corrosion, nondestructive testing, elasticity, theories of failure, etc. Though intended for practicing design and research engineers, the book is suitable for use by more advanced students. Appended to most sections is a bibliography of recommended reading matter. Publisher, McGraw-Hill Book Company, Inc., 330 W. 42nd Street, New York 36, N. Y. Price, $10.00.

Stanat Manufacturing Company has available an 8-page bulletin—Publication No. 121—which describes and illustrates its laboratory and production rolling mills with standardized interchangeable parts and its complete line of mill accessories.

Circle 26E on reply card

A 16-mm sound-color motion picture, *Digging for Your Future*, is offered on a loan basis by the Bucyrus-Erie Company and is described fully in a leaflet. The film shows the company's products from conception to application and how they have helped to reshape the earth.

Circle 27E on reply card

Thor rayon transmission belting is described in a 4-page folder, No. A5163K, just issued by Goodyear Tire & Rubber Company. This new belting with rayon instead of cotton plies was field-tested for more than four years on jobs selected because of their severity.

Circle 28E on reply card

Bulletin No. 600 recently published by Dollinger Corporation describes its Staynew ventilating and air-conditioning filters of the dry panel type designed for the removal of air-borne impurities. Engineering and performance data are included in the 8-page illustrated brochure.

Circle 29E on reply card

Bulletin 2553 published by Hagan Corporation deals with its heavy-duty pneumatic signal transmitter for measuring, indicating and controlling fluid flow and

THE SHOW MUST GO ON

In the theatre of construction, Naylor light-weight pipe is constantly proving its performance ability. Take this scene from the building of the New York Thruway showing a line of 8-inch Naylor pipe feeding air to rock drills. Despite the constant battering from flying rock and the terrific impact of a fallen tree, there's no interruption in the lines and the show goes on. If this is the kind of performance you need for your jobs, write for Bulletin No. 507 and get the complete story.

NAYLOR PIPE

Naylor Pipe Company • 1245 East 92nd Street, Chicago 19, Illinois

Eastern U.S. and Foreign Sales Office: 350 Madison Avenue, New York 17, New York

Circle 21A on reply card

How to get drier or cooler air or gases . . .

NIAGARA AERO AFTER COOLER cools a compressed gas, or air, below the temperature of the surrounding atmosphere, thus preventing the condensation of moisture in your lines. The gas will contain only half of the moisture left in it by conventional methods. Even drier gas can be produced if you require it.

In working with controlled atmospheres of inert gases to prevent undesired reactions, this dryness of the gas at low cost is a great advantage. The cost of the Niagara method is low because it uses evaporative cooling, saving 95% of the cost of cooling water (and its piping and pumping). This direct saving of cost pays for the Niagara cooler in less than two years.

If you use compressed air to operate tools or pneumatic equipment you save much in water and oil damage to tools and equipment, and in water damage to materials by using the Niagara Aero After Cooler.

Write for a bulletin, or ask nearest Niagara Field Engineer if you have a problem involving the industrial use of air.

NIAGARA BLOWER COMPANY

Over 35 Years' Service in Industrial Air Engineering

Dept. CA , 405 Lexington Ave. New York 17, N. Y.

Experienced Field Engineers in Principal Cities of U. S. and Canada

Circle 22A on reply card

liquid level at operating pressures up to 1500 psi and pressure differentials up to 100 psi for steam generation and process control. Construction, operation and application are discussed in some detail.

Circle 30E on reply card

Bulletin No. 853 prepared by W. H. Nicholson & Company features its steam traps with bronze, monel or stainless-steel bellows and bodies of bronze, semisteel and cast steel in sizes from ¼ inch to 2 inches for pressures from vacuum to 300 psi. Subject matter includes capacity tables, piping diagrams, typical applications, and data on the selection of traps for varying types of steam equipment.

Circle 31E on reply card

Ingersoll-Rand Company has issued a leaflet that deals with its Motorpumps for use in the dry-cleaning field where it is common practice to pass the solvent from 20 to 30 times through the wash filter system to prevent soiling the garments. The folder contains performance curves that will enable operators to select the pumps that will meet their service requirements.

Circle 32E on reply card

Publication of the third edition of the *Storage Battery Technical Service Manual* has been announced by the Association of American Battery Manufacturers. The 44-page booklet enters into the construction of automotive batteries and tells how to install, service and repair them. A section is devoted to car generator systems, which must operate properly for long battery life.

Circle 33E on reply card

An easy-to-read chart of pocket size printed on dirt-resistant vinylite gives fractions and decimal equivalents from 1/64 to 1 inch in 64ths on one side and National coarse and fine threads, pipe threads, and ASME standard and special threads with equivalent tap and body drill sizes on the other. It will be sent free to supervisors, foremen, machinists, tool engineers and draftsmen by Reiff & Nestor Company.

Circle 34E on reply card

Honeywell pyrometer supplies are illustrated and described in the newly revised 48-page Buyers' Guide 100-5 being distributed by Minneapolis-Honeywell Regulator Company, Wayne and Windrim avenues, Philadelphia 44, Pa. It lists all general thermocouple assemblies and components, as well as many special-purpose items, and also contains information on the selection, care and application of thermocouples.

Circle 35E on reply card

Reinhold Publishing Corporation is distributing the 1953-54 edition of its *Chemical Engineering Catalog*, the thirty-eighth printing of this standard reference work for chemical engineers and production men. A volume of 1955 pages, it gives precise and factual information on equipment and materials offered by more than 515 leading companies in the field. It has company-name, functional, classified and trade-name indices for easy reference.

Circle 36E on reply card

Le-Hi Quick-Lock Hose Couplings and fittings for air, gas, water, oil, hydraulic or steam lines are discussed in an 8-page bulletin released by Hose Accessories Company. It tells where each of the six types produced are to be used and deals with its U-shaped gasket that expands and provides a tight seal under pressures from 10 to 2000 psi in hydraulic service and under 1500 psi in nonpoisonous, nonflammable gas service.

Circle 37E on reply card